

**A Beaver Original from Hamlyn**

Whether you want to make a Christmas tree, a picture frame, a tantalising puzzle or simply some pretty decorations, this book will show you how. Step-by-step instructions and line drawings explain how to make basic shapes out of paper – and then show how these shapes can be used in all kinds of fascinating ways. Toys, tangrams, sculptures, jewellery, paper chains and lots of other things can all be constructed easily and simply. All you need are some sheets of paper and a pair of scissors and you'll have hours of fun!

*Cover photograph by Bror Lawrence*

**Eric Kenneway**

# PAPER SHAPES



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# PAPER SHAPES

Eric Kenneway

*Illustrated by Alan Rogers*



Beaver Books

## CONTENTS

<b>Preface</b>	7
<b>A key to symbols used in the diagrams</b>	8
<b>Making Shapes: Basic Designs</b>	9
Making a square from paper of any irregular shape	10
Making a square from a rectangle	12
Making an equilateral triangle	13
Making a diamond	14
Making a cross	15
Making an eight-sided figure	17
Making a sixteen-sided figure	19
Making an eight-pointed star	20
Making a sixteen-pointed star	21
Making a six-sided figure	22
Making a twelve-sided figure	24
Making a six-pointed star	25
Making a five-pointed star	26
Making six hexagons	29
Making lots of squares	31
Developing basic shapes	34
'Frame' shapes	36
1 Eight-pointed star	36
2 Six-pointed star	37
<b>Joining Shapes: Patterns and Decorations</b>	39
Frieze	40
Simple paper chains	42
Paper chains and garlands	45
Flower chains	49
Simple repeat patterns	50
Alternating repeat patterns	51



Radial flower patterns	52	
Three-dimensional star	53	
Standing Christmas tree	54	
Joining shapes to make solids	56	
1 Container	56	
2 Jewel and necklace	58	
3 Pyramid	60	
Shapes into sculpture	61	
Twenty-piece ball	64	
'Woven' ball	67	
<b>Changing shapes: Toys and Puzzles</b>		<b>71</b>
Spinning dice	72	
Dominoes	73	
Tangrams	74	
Paper ball puzzle	81	
Box cube	87	
Frame, egg and diamond puzzle		91

## Preface

If you cut through the several layers of a folded sheet of paper and then open it up, you will probably find that you have created something quite different from what you imagined would result. Folding paper and cutting out shapes in this way can be a constant source of surprise and wonderment. From the following pages you will learn ways of making many basic shapes – squares, triangles, diamonds, stars and polygons – and also discover ideas for combining shapes in flat patterns and three-dimensional decorations.

The main things you will need are a pair of scissors and quite a lot of paper. For your first attempts you might choose to make your shapes from the pages of an old magazine; if so, make sure that it is an old magazine and no longer needed by its owner. When you have had some practice you will surely want to make your shapes from papers which are a bit more special. Packets of coloured paper squares, sometimes gummed on the reverse side, can be found in many stationery shops and toy shops. These are ideal for most projects. For the more complicated designs which have many layers of paper, try using coloured tissue papers. Some constructions, where one shape slots into another, should be made from thin card rather than paper.

Shapes made by folding and cutting will inevitably show unwanted creases which appear as a result of their method of construction. These creases can be removed by having a grown-up run over the unfolded shape with a cool iron.

As well as using shapes to make patterns and decorations, you can use them as puzzles or toys. Do not imagine that the possibilities are limited to what is described in this book. Experiment and discover for yourself some of the infinite variety of shapes and patterns that can be created.

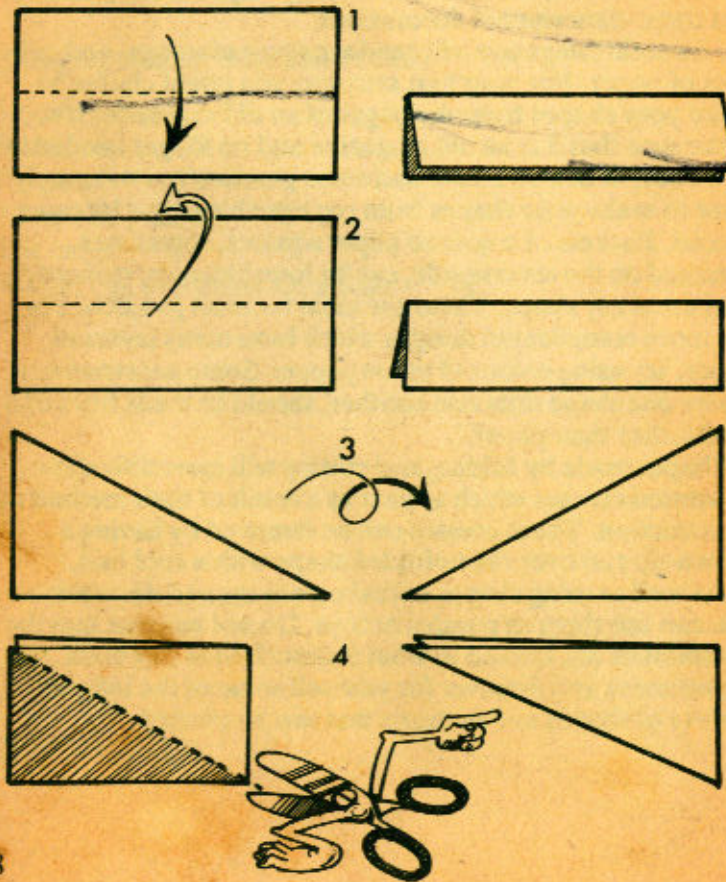
E.K.



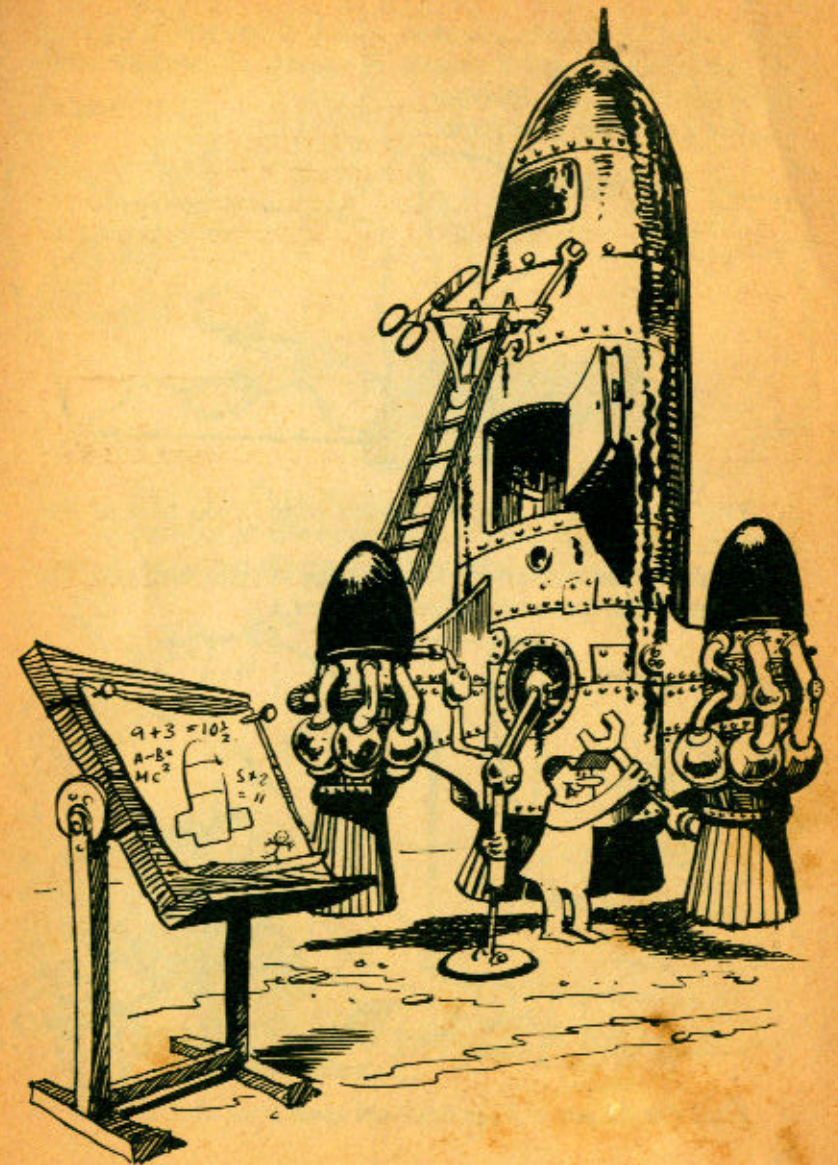
### A key to symbols used in the diagrams

The following symbols are used throughout this book:

- 1 A broken line means, 'Fold'. The arrow shows the direction of the fold.
- 2 When the fold line is accompanied by a hollow-headed arrow, you should fold the paper away from you.
- 3 A looped arrow means, 'Turn the paper over'.
- 4 A pair of scissors means, 'Cut'. A heavy broken line shows where to cut, and the shaded part of the paper should be discarded.



### Making Shapes: Basic Designs

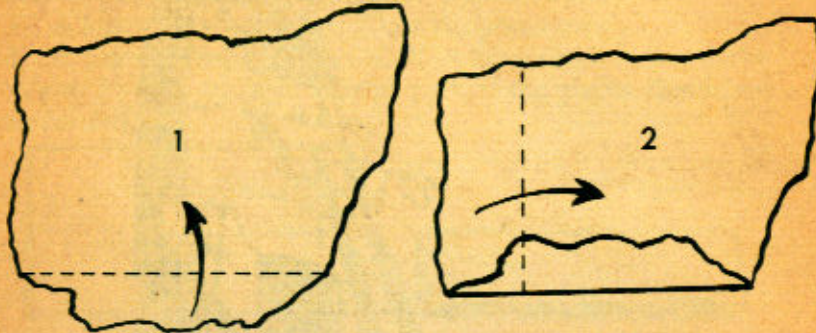




### Making a square from paper of any irregular shape

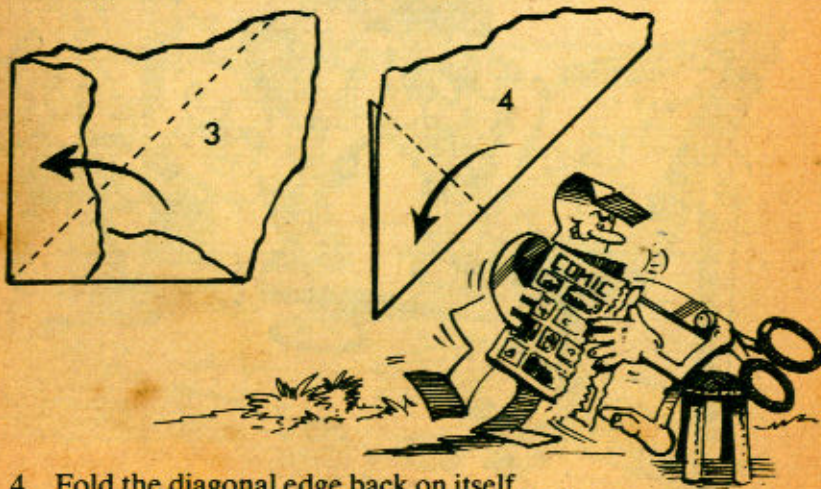
Let us start by making a square, a basic shape which we shall use to make many other shapes. A square can be made from any scrap of paper as follows:

1 Make a fold in your paper.

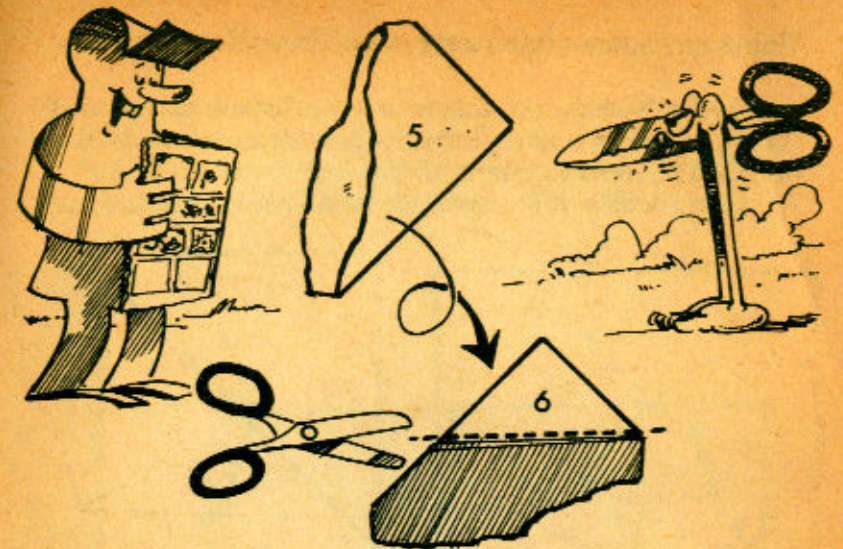


2 You now have a straight folded edge. Fold part of this edge back on itself.

3 You now have a second folded edge at right-angles to the first edge. Fold these two edges together.

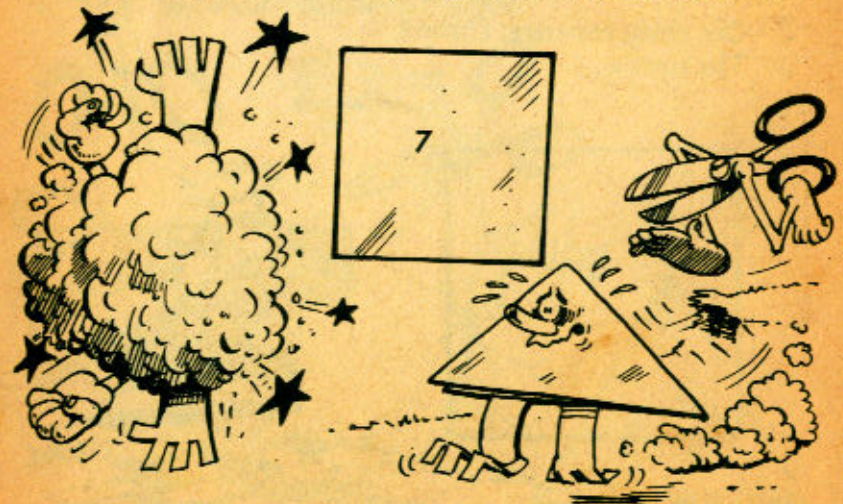


4 Fold the diagonal edge back on itself . . .



5 . . . like this. Turn over.

6 Cut parallel to the horizontal straight edge, just above it. Unfold the paper, discarding the part shown as a shaded area.



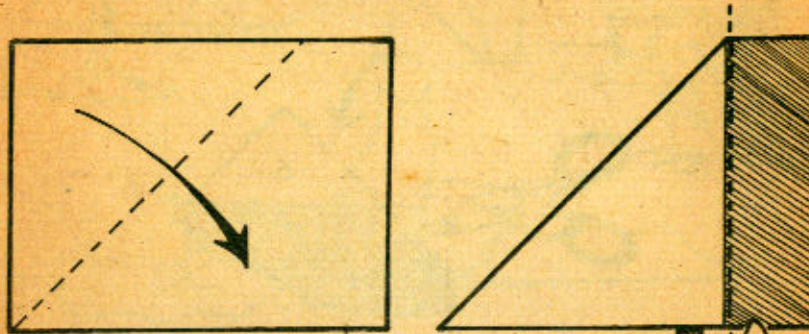
7 You should have a perfect square.



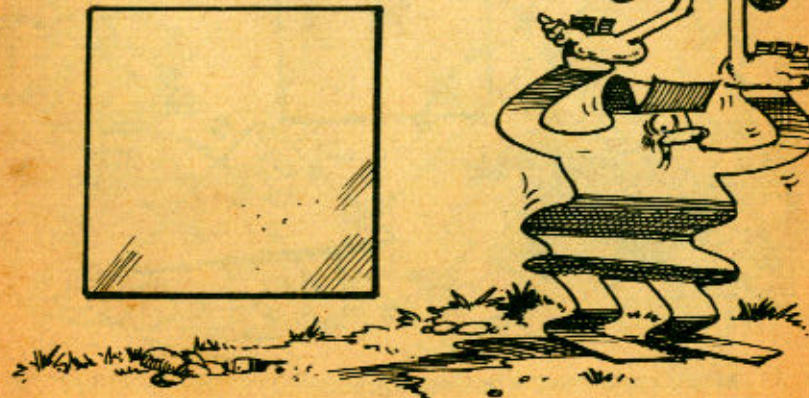
### Making a square from a rectangle

Instead of a very odd-shaped piece of paper, you are more likely to have a rectangle from which to start. It is a simple matter to make a square from this.

- 1 Fold the side of the rectangle to the bottom edge.



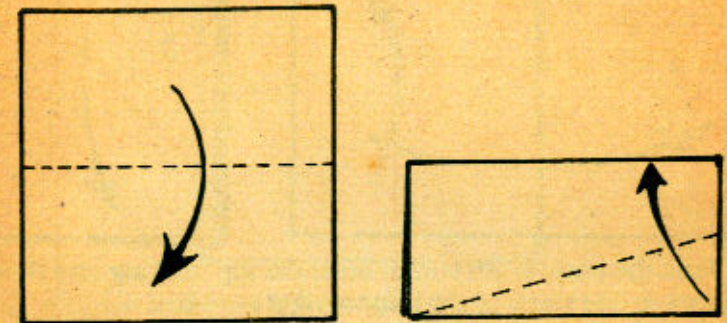
- 2 Cut along the edge. Unfold.
- 3 The square.



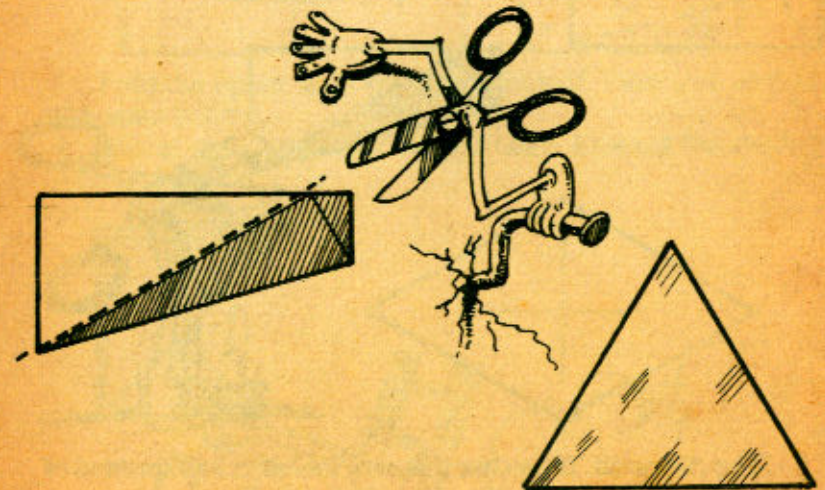
### Making an equilateral triangle

Use a square of paper.

- 1 Fold the top edge to the bottom edge.
- 2 Fold the bottom right corner to the top, making sure that the crease line starts from the bottom left corner.



- 3 Cut along the edge. Discard the shaded area and unfold.
- 4 The completed equilateral triangle.

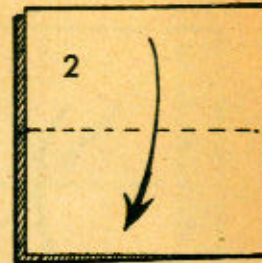
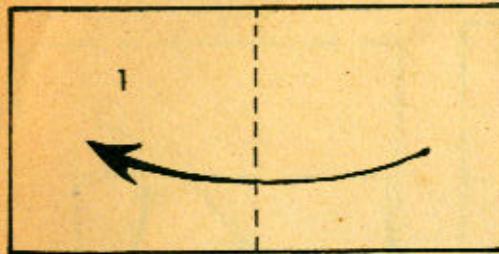




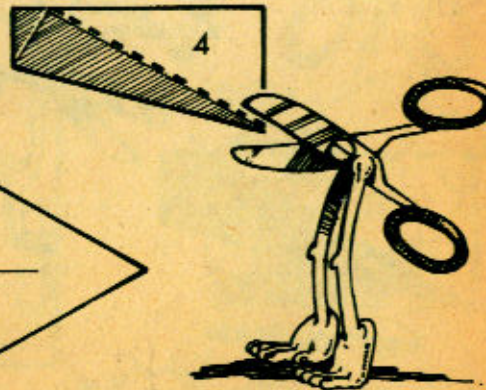
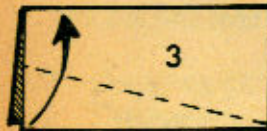
### Making a diamond

Use a  $2 \times 1$  rectangle of paper (half of a large square, or two smaller squares joined together).

- 1 Fold in half from right to left.
- 2 Fold top to bottom.



- 3 Fold the bottom left corner up to the top, making sure that the crease line starts at the bottom right corner.
- 4 Cut along the edge. Discard the shaded area and unfold.

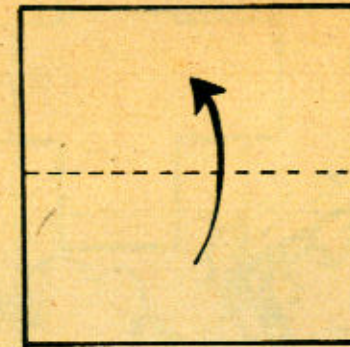


- 5 The diamond. If you use a square folded in half, instead of a  $2 \times 1$  rectangle, you will make two diamonds together.

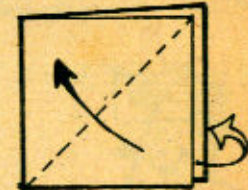
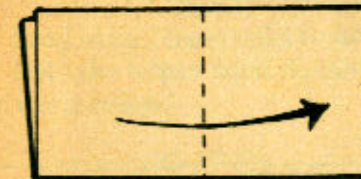
### Making a cross

Use a square of paper.

- 1 Fold in half from bottom to top.

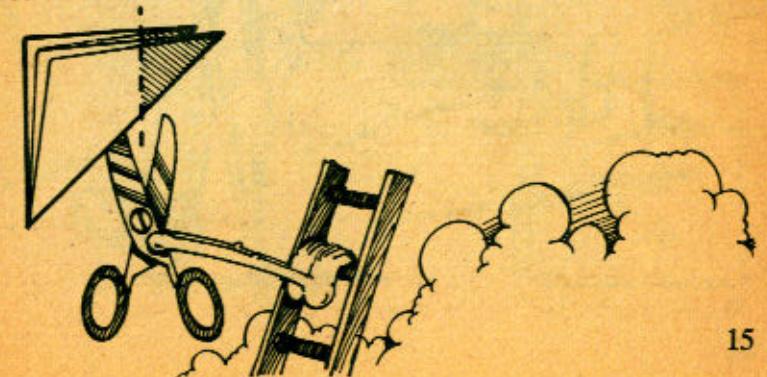


- 2 Fold in half from left to right.



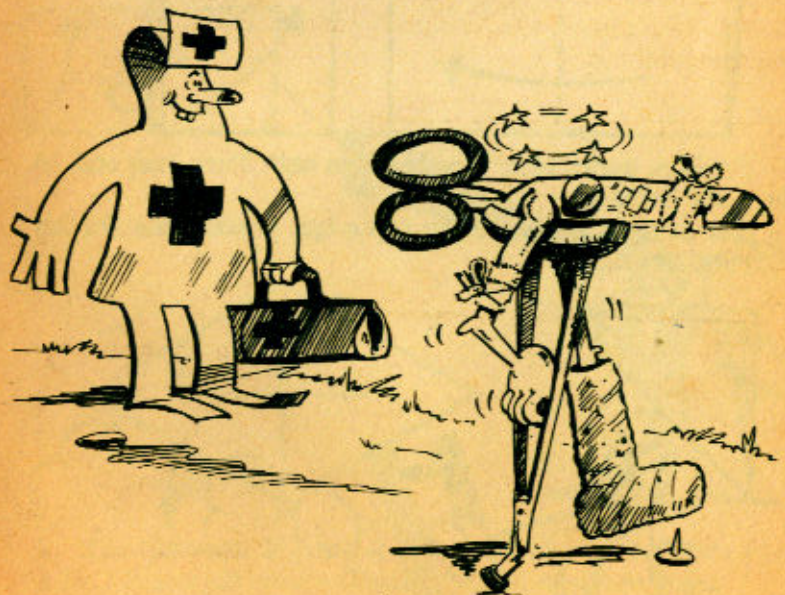
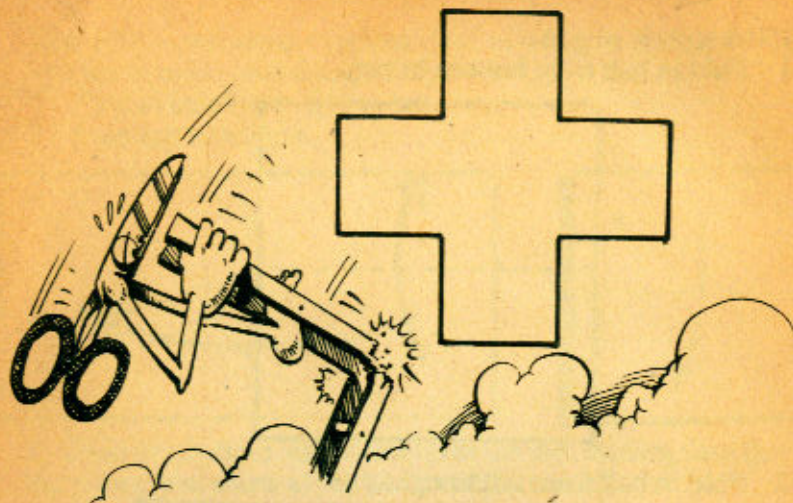
- 3 Fold the upper layer diagonally in half. Turn over and do the same behind.

- 4 Cut at right angles to the top edge. Discard the shaded area and unfold.





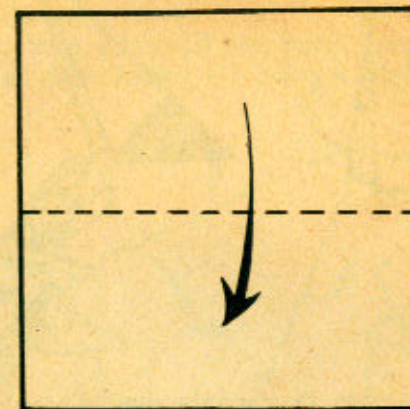
# 5 The cross.



## Making an eight-sided figure

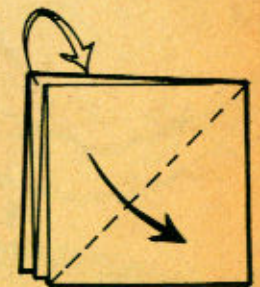
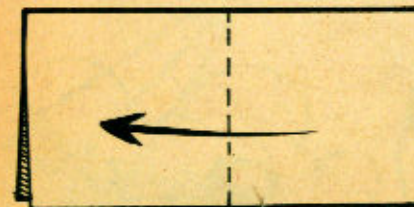
Use a square of paper.

1 Fold in half from top to bottom.



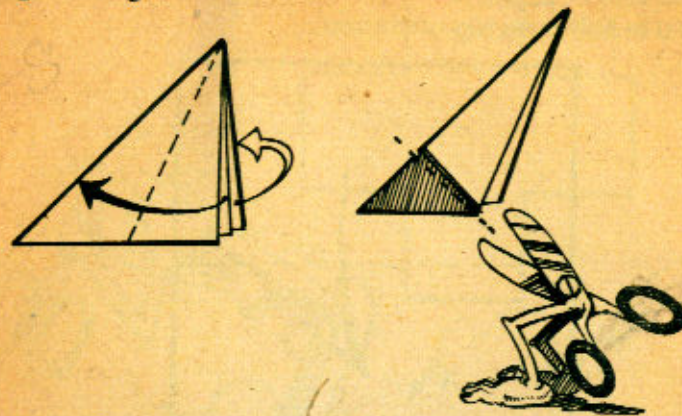
2 Fold in half from right to left.

3 Fold the upper layer diagonally in half. Turn over and do the same behind.

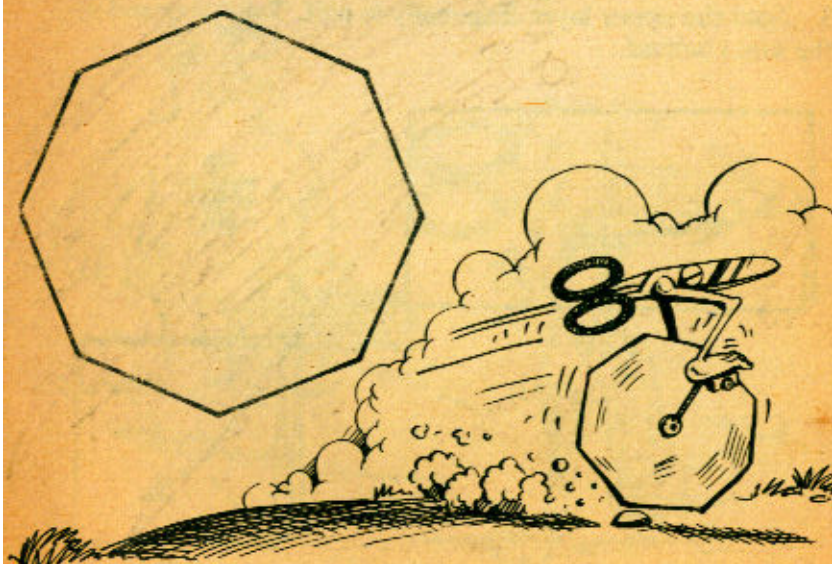




- 4 Fold the vertical edges (two layers) to the diagonal edge at left. Turn over and fold the remaining vertical edge to the diagonal edge.



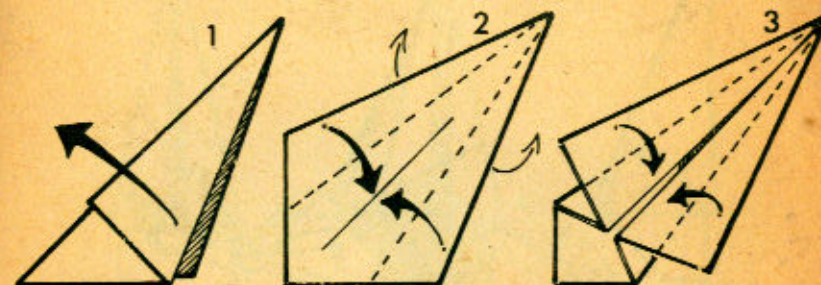
- 5 Cut along the edge. Discard the shaded area and unfold.  
6 The eight-sided figure.



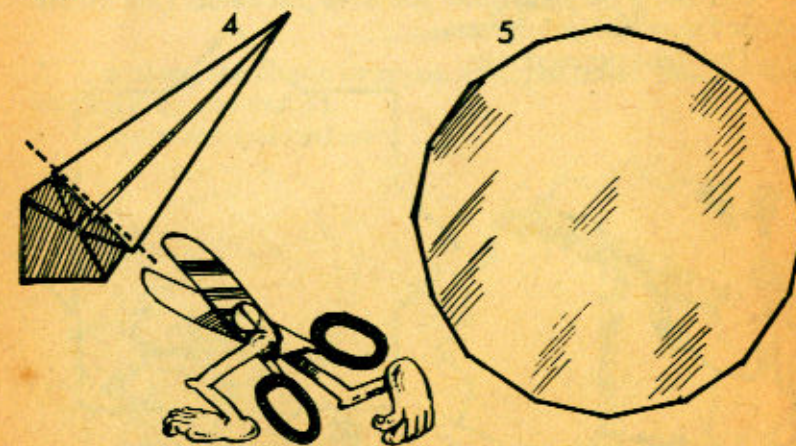
### Making a sixteen-sided figure

Use a square of paper. Start by folding steps 1-5 of the eight-sided figure (page 17).

- 1 Unfold the upper layer.  
2 Fold the long edges of the 'kite' shape to the centre crease line in turn, letting the hidden edges kick out from underneath . . .



- 3 . . . like this. Fold these edges to the centre crease line too.



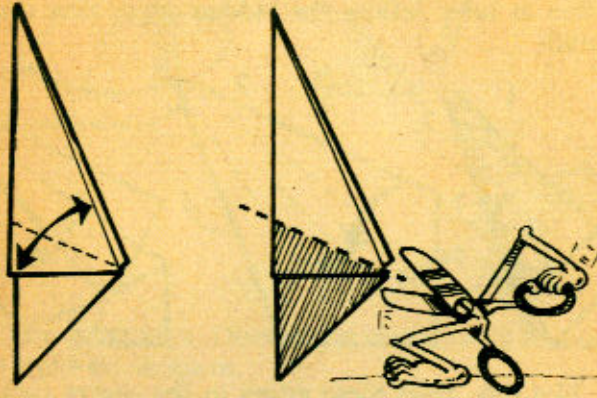
- 4 Cut along the edge. Discard the shaded area and unfold.  
5 The sixteen-sided figure.



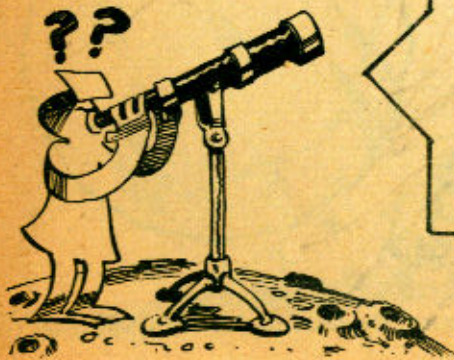
### Making an eight-pointed star

Use a square of paper. Start by folding steps 1-5 of the eight-sided figure (page 17).

- 1 Fold the two adjacent edges of the uppermost flap together, crease and unfold.



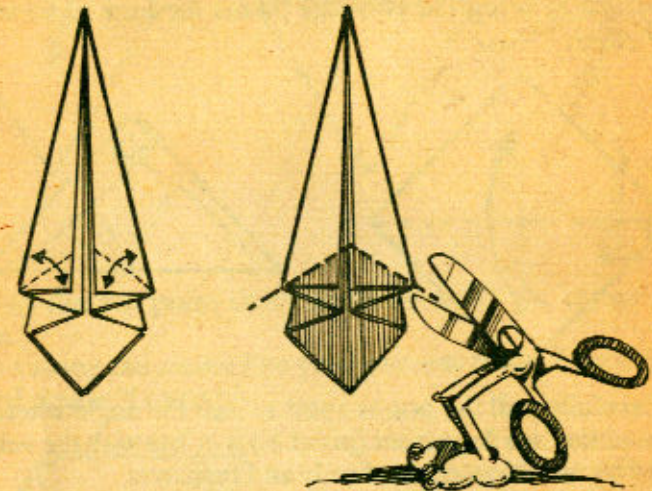
- 2 Cut along the crease line you have just made. Discard the shaded area and unfold.
- 3 The eight-pointed star.



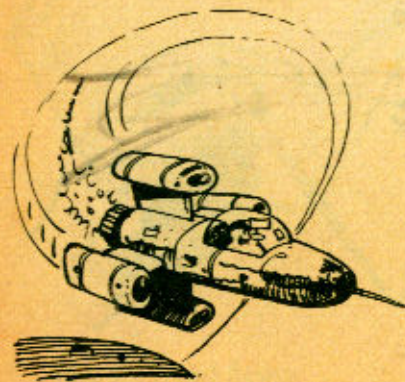
### Making a sixteen-pointed star

Use a square of paper. Start by folding steps 1-4 of the sixteen-sided figure (page 19).

- 1 Fold the two adjacent edges of the uppermost flaps together in turn, make creases and unfold.



- 2 Cut along the crease lines you have just made. Discard the shaded area and unfold.
- 3 The sixteen-pointed star.

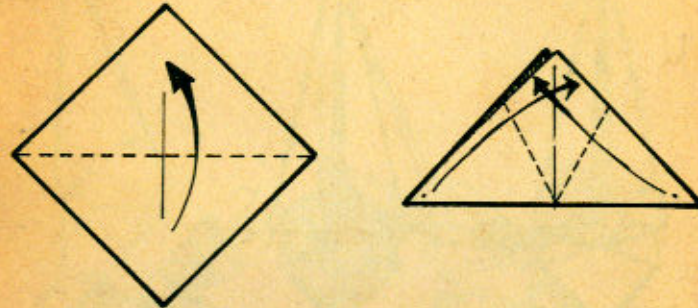




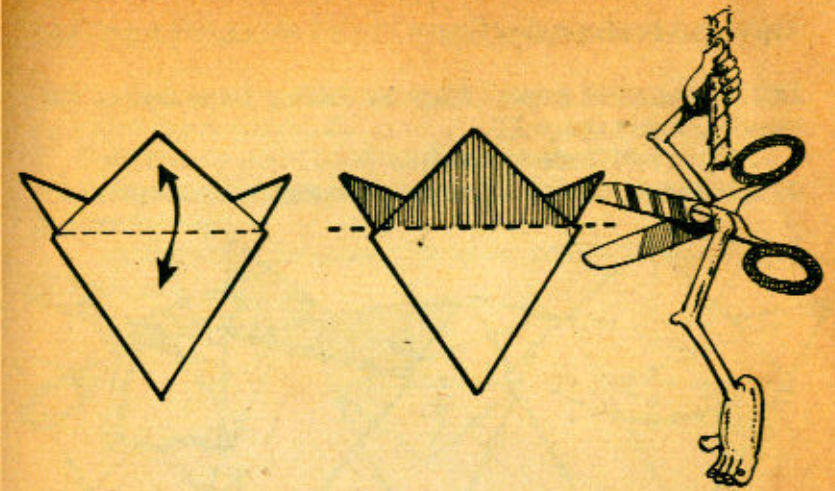
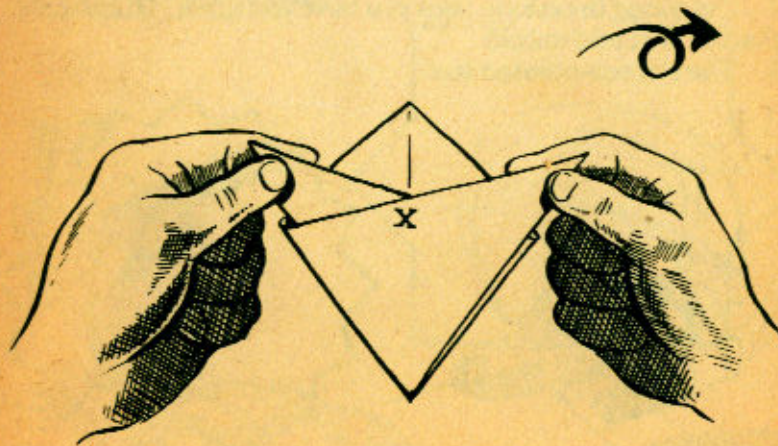
### Making a six-sided figure

Use a square of paper. First fold two opposite corners together, make a crease and unfold.

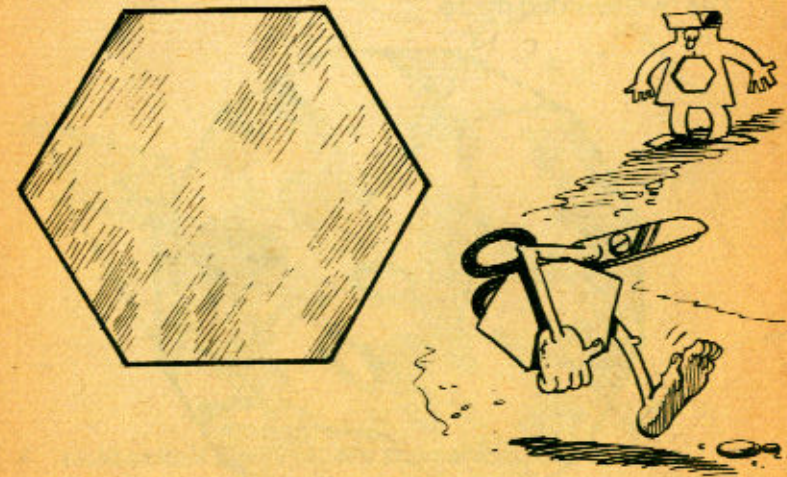
- 1 Fold the other two corners together and leave folded.
- 2 Making sure that the creases start from the centre of the folded edge, bring the two side points forward to lie across each other.



- 3 Carefully pull the points apart so that the angle where the edges of the two flaps meet (point X) is in line with the vertical centre crease. Now crease firmly and turn over.



- 4 Fold the top point down as far as it will go, crease and return.
- 5 Cut along the crease line you have just made. Discard the shaded area and open up.



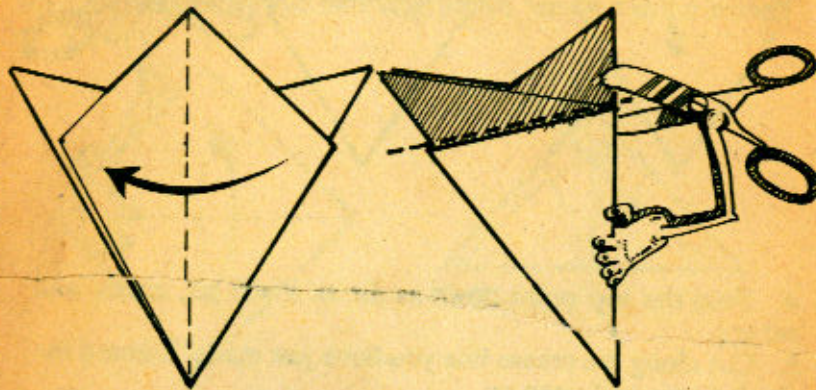
6 The six-sided figure.



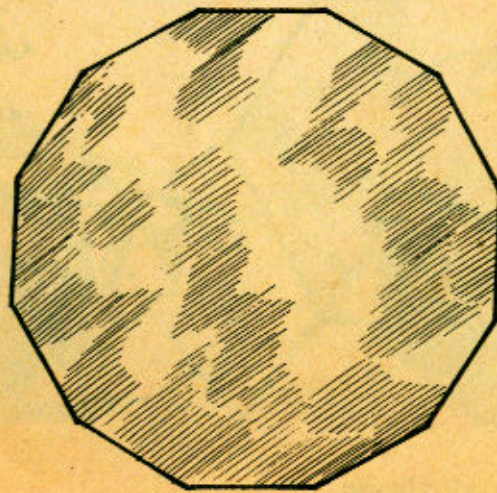
### Making a twelve-sided figure

Use a square of paper. Start by folding steps 1-4 of the six-sided figure (page 22).

- 1 Fold in half from right to left.
- 2 Cut along the edge. Discard the shaded area and open up.



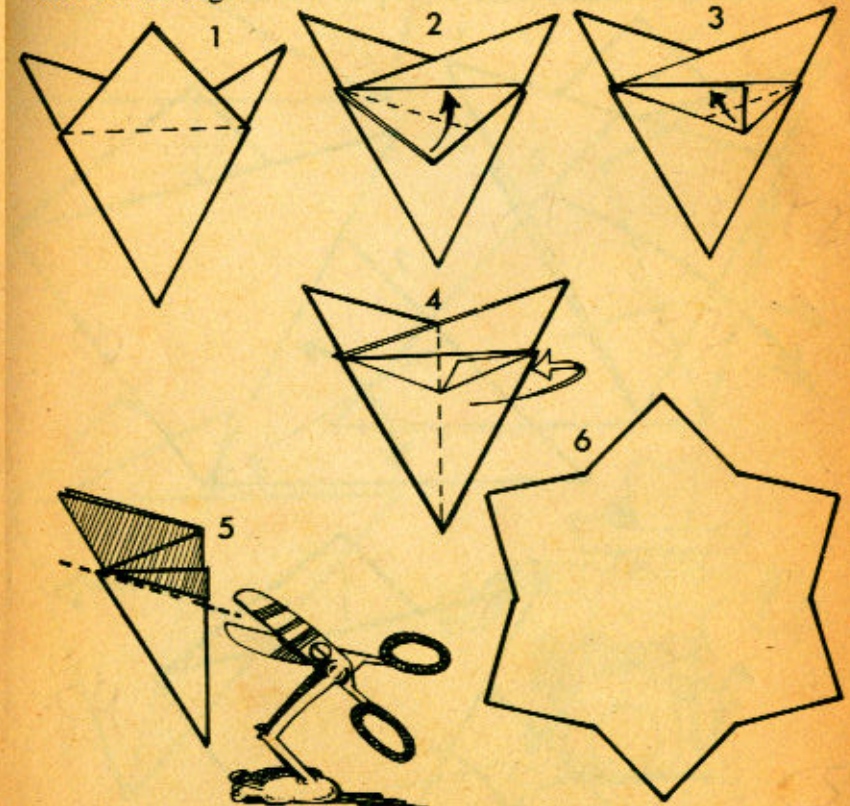
3 The twelve-sided figure.



### Making a six-pointed star

Use a square of paper. Start by folding steps 1-3 of the six-sided figure (page 22).

- 1 Fold the top point down as far as it will go.
- 2 Fold one of the diagonal edges of the central triangle to the horizontal edge.
- 3 Fold the other diagonal edge of the central triangle to the horizontal edge.



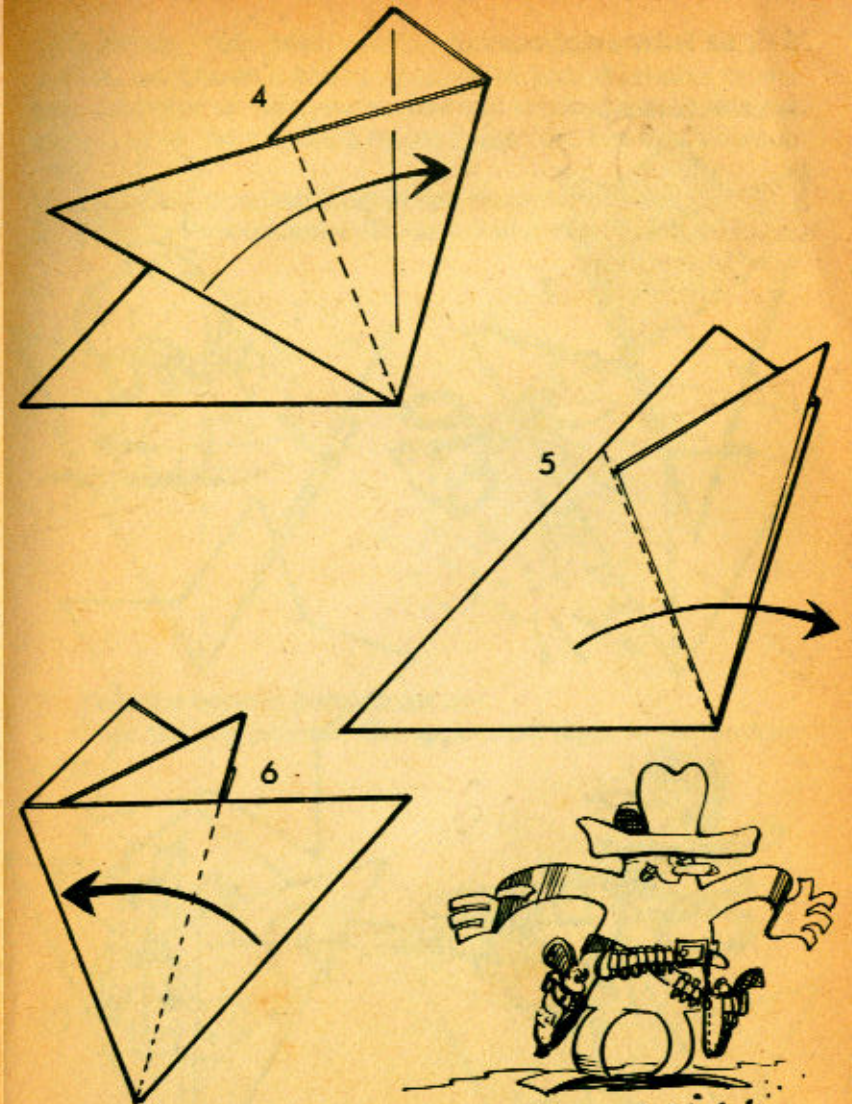
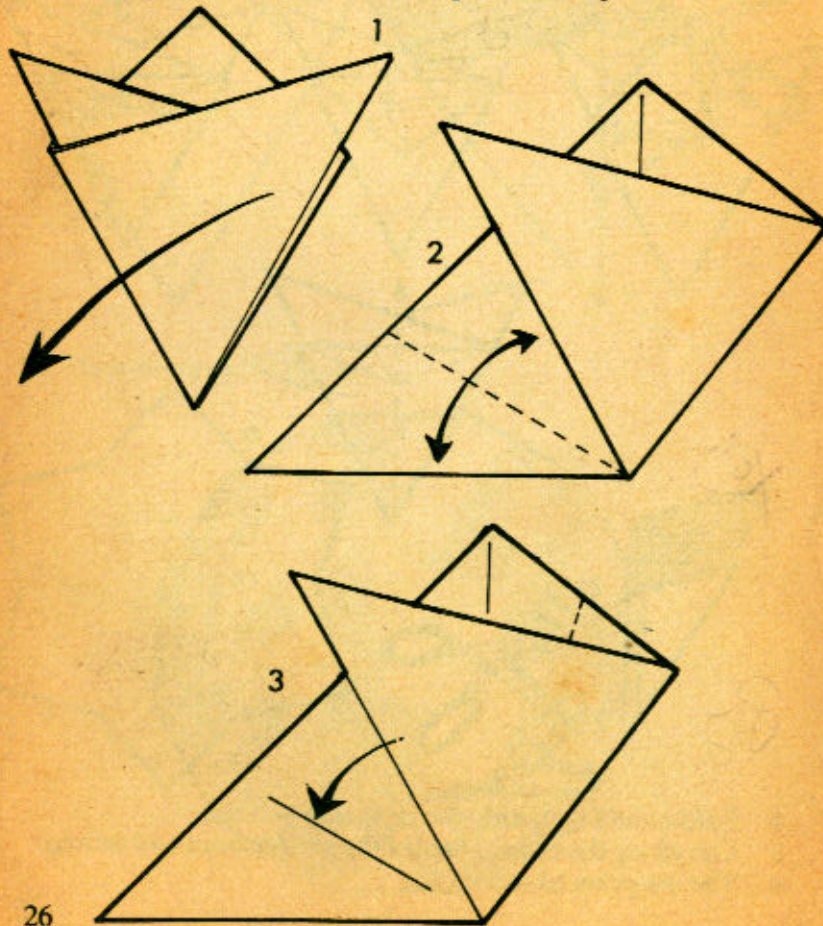
- 4 Fold in half by taking the right side behind.
- 5 Cut along the edge. Discard the shaded area and unfold.
- 6 The six-pointed star.



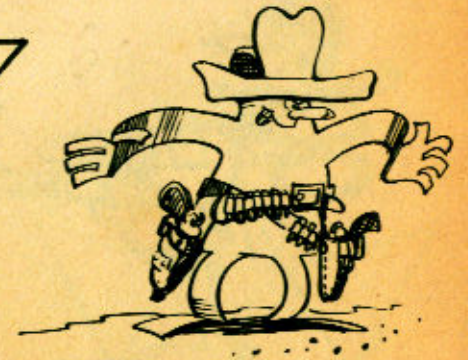
### Making a five-pointed star

Use a square of paper. Start by completing steps 1-3 of the six-sided figure (page 22).

- 1 Unfold the uppermost flap.
- 2 Fold the bottom edge to the diagonal edge. Make a crease and open flat again.
- 3 Now reposition the triangular flap so that its lower edge lies along the crease made in the previous step.

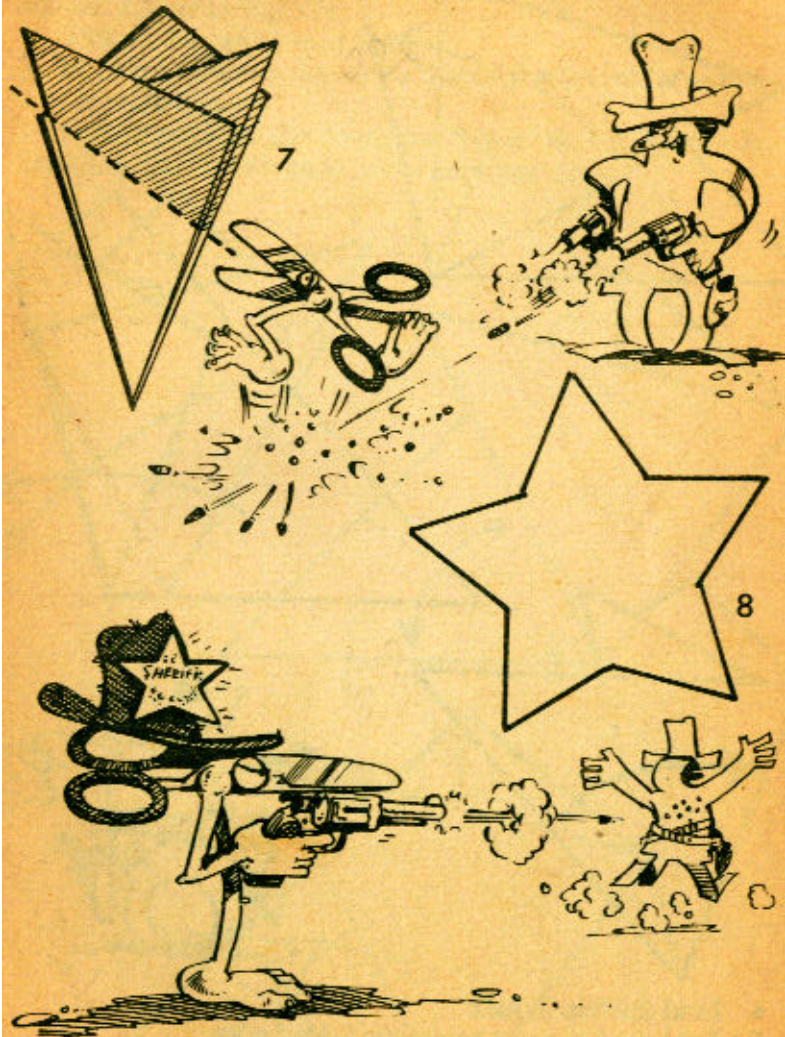


- 4 Fold the flap in half.
- 5 Fold the left point across the folded edge.
- 6 Bring the flap back to the left.





7 Cut from a point about halfway down the right edge to where several folded edges meet at left. Discard the shaded area and open up.

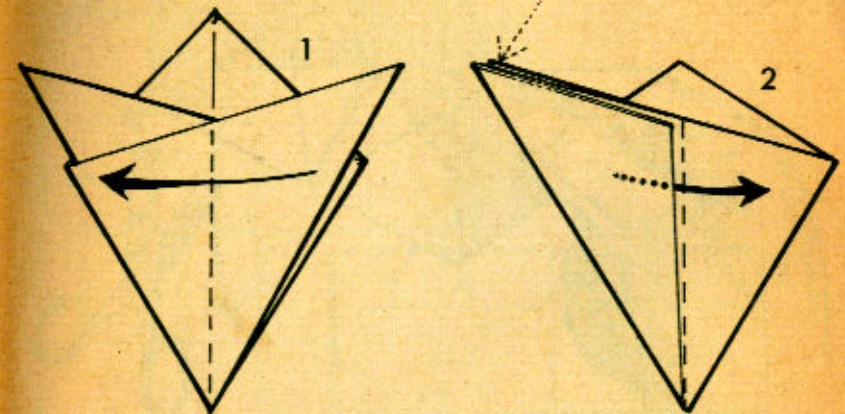


8 The five-pointed star.

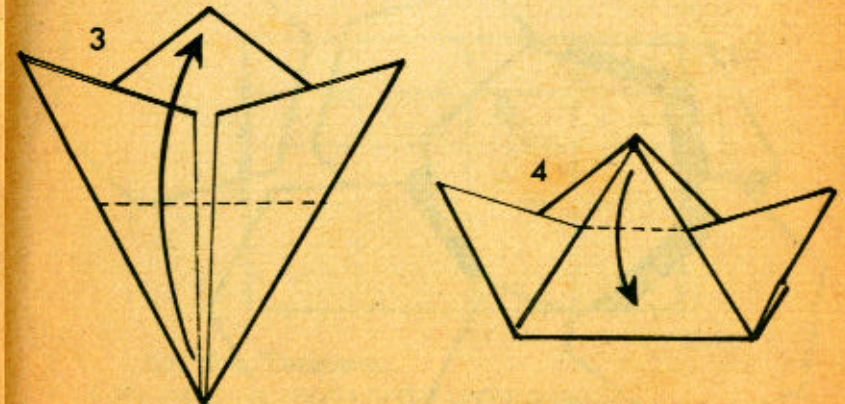
### Making six hexagons

Use a square of thin paper, not too small. Start by folding steps 1-3 of the six-sided figure (page 22), but don't turn it over.

- 1 Fold the uppermost flap in half from right to left.
- 2 Pull out the concealed flap and fold it in half similarly.

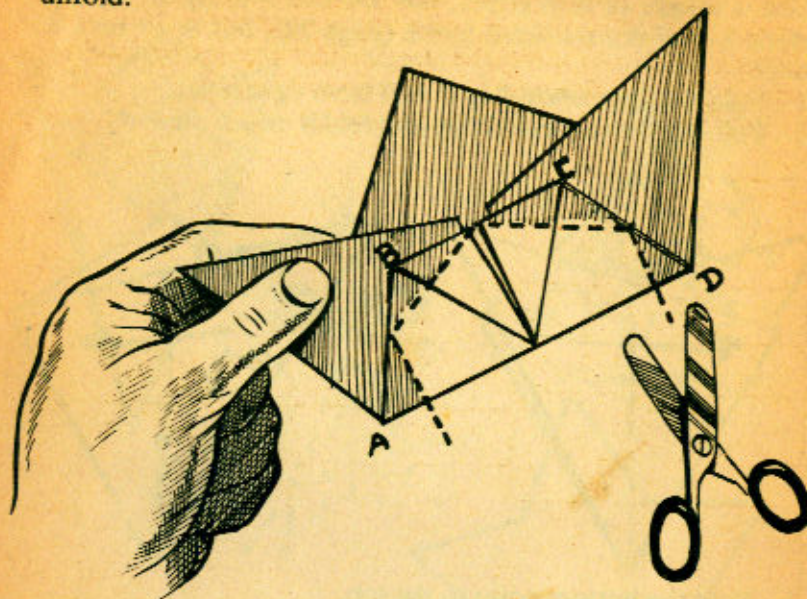


- 3 Fold the bottom point to the top.
- 4 Fold the top point of the uppermost layer to the bottom edge.

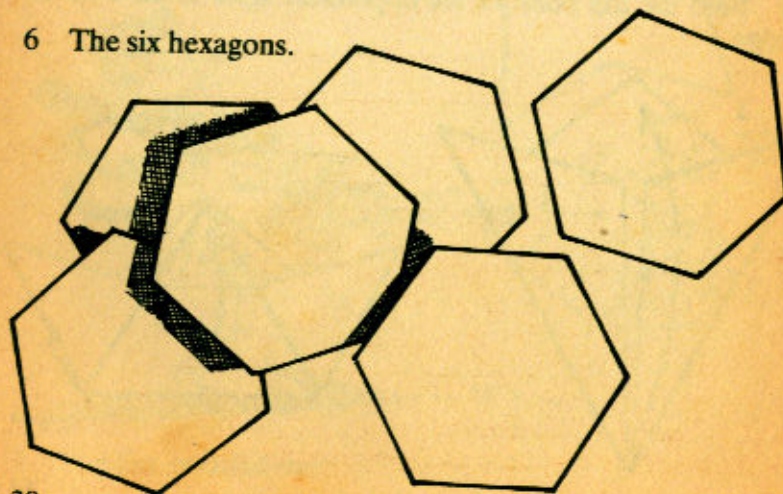




5 Find the centre of the edges AB, BC and CD. Cut straight lines between these points. Discard the shaded area and unfold.



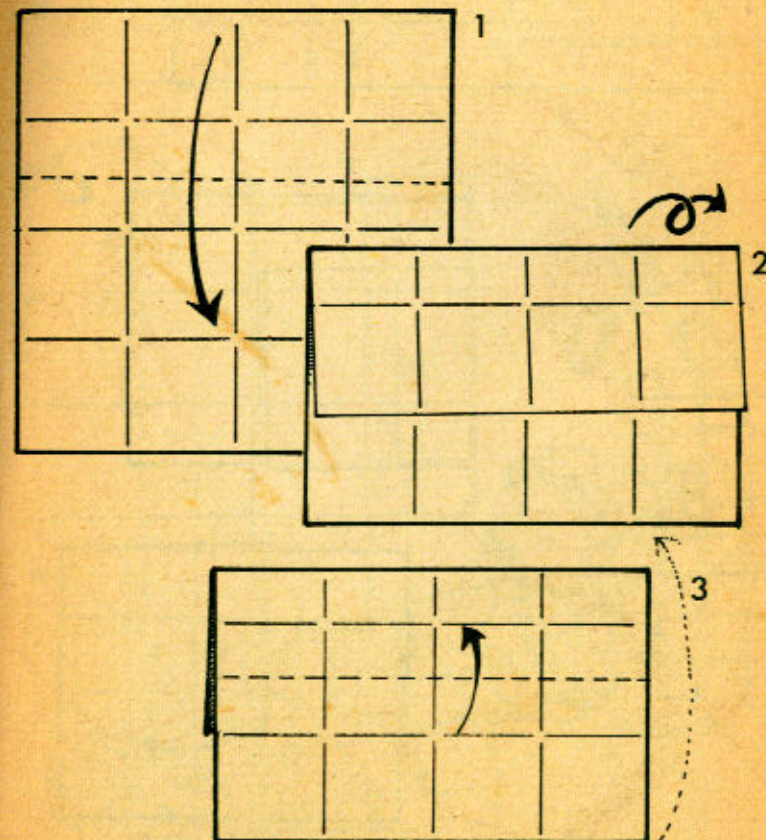
6 The six hexagons.



## Making lots of squares

Use a square of thin paper, not too small. Mark the centre creases by folding the opposite edges together in turn and opening up. Then mark the quarter-line creases by folding each edge to the centre in turn and opening up.

1 Fold the top edge to the lowest crease . . .

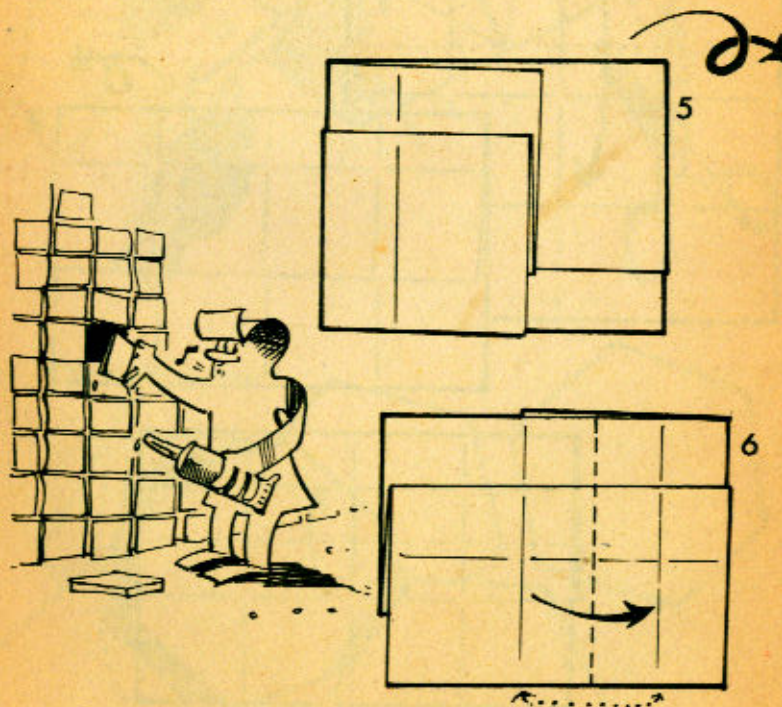
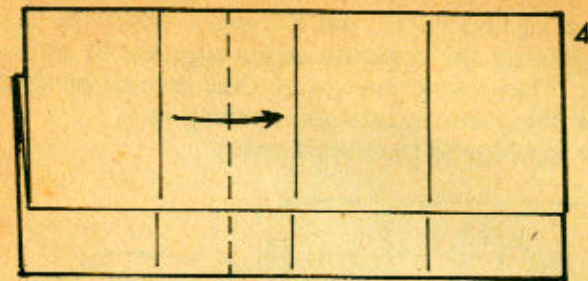


2 . . . like this. Turn over.

3 Fold the lower crease to the upper crease.



4 Fold the left crease to the centre . . .



5 . . . like this. Turn over.

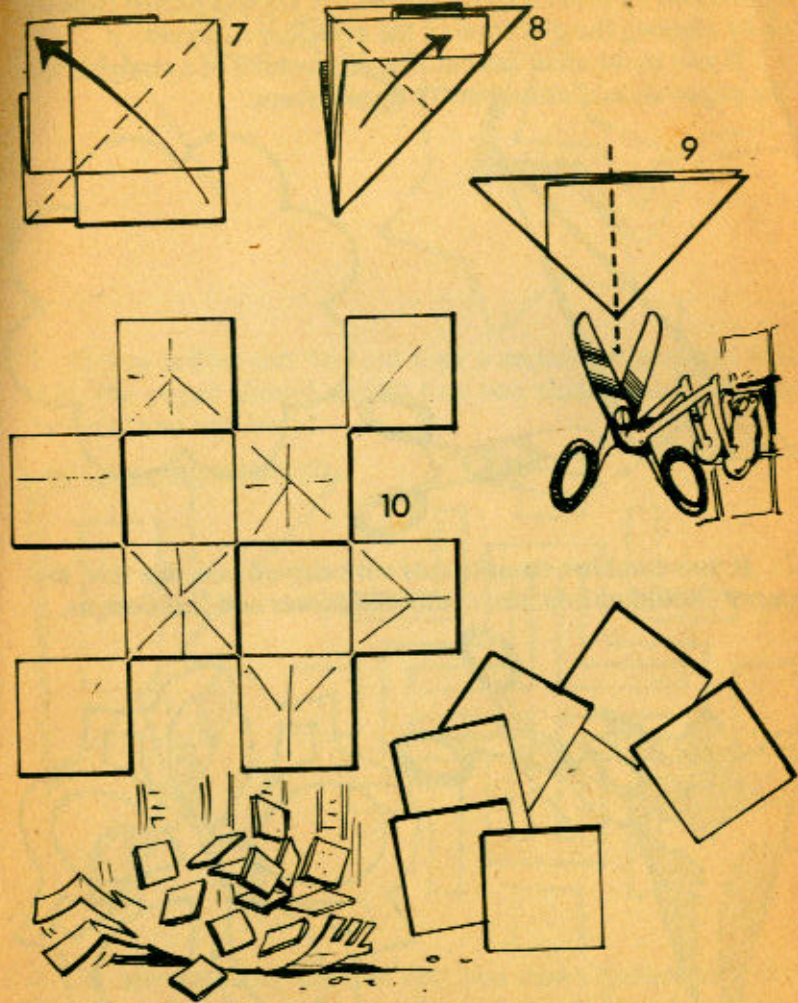
6 Fold the left crease to the right crease.

32

7 Fold diagonally in half . . .

8 . . . and in half again.

9 Cut in two. Unfold.



10 With one cut you have made lots of little squares, some of which may still be joined at the corners.

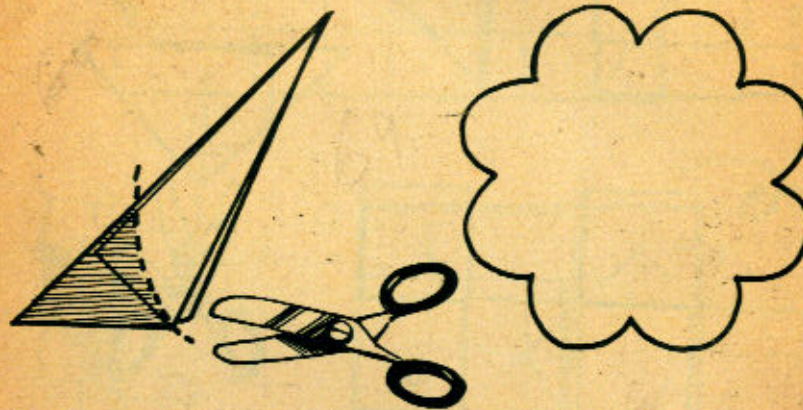
33



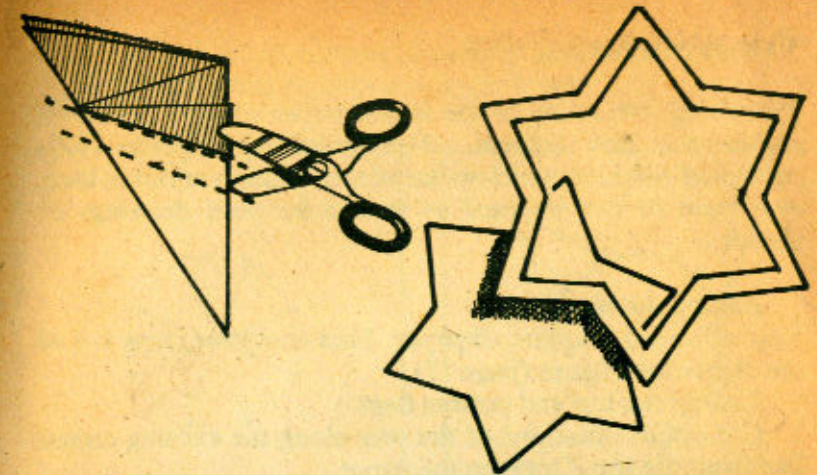
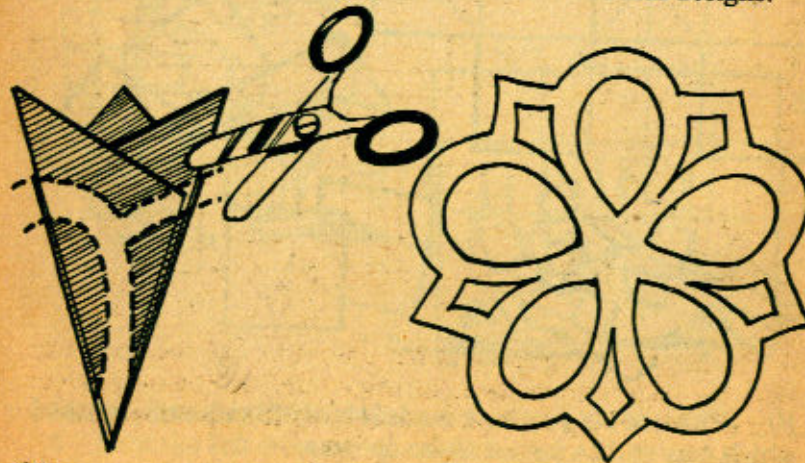
### Developing basic shapes

All of the shapes described on the previous pages can be developed by making extra cuts in the various folded papers, or by altering the direction of the cuts. For example:

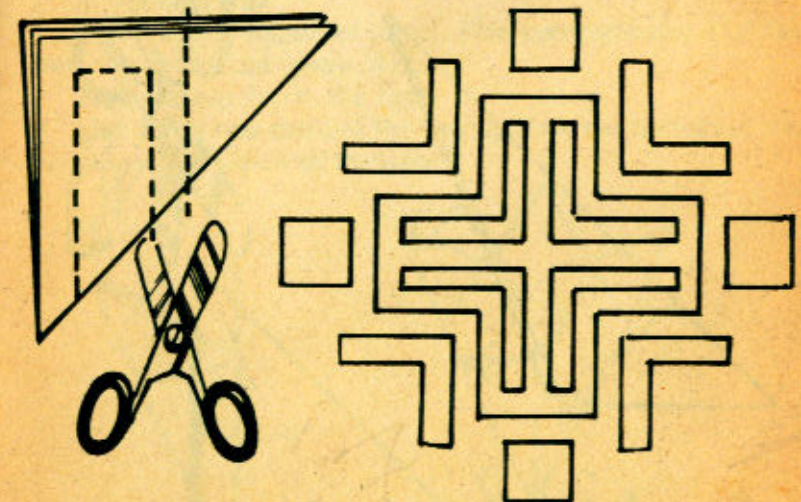
1 If you make a curved cut like this instead of a straight cut, the paper should unfold into a flower shape.



2 If you combine straight cuts with curved cuts like this, the paper should unfold into combined flower and leaf designs.



3 If you follow the first cut with a second parallel cut like this, the paper should unfold into two similar shapes – one 'hollow' and one 'solid'.



4 If, after making the first cut, you make further cuts like this, the result should be a perforated shape. You may like to embellish the basic shape by arranging the discarded pieces around it.



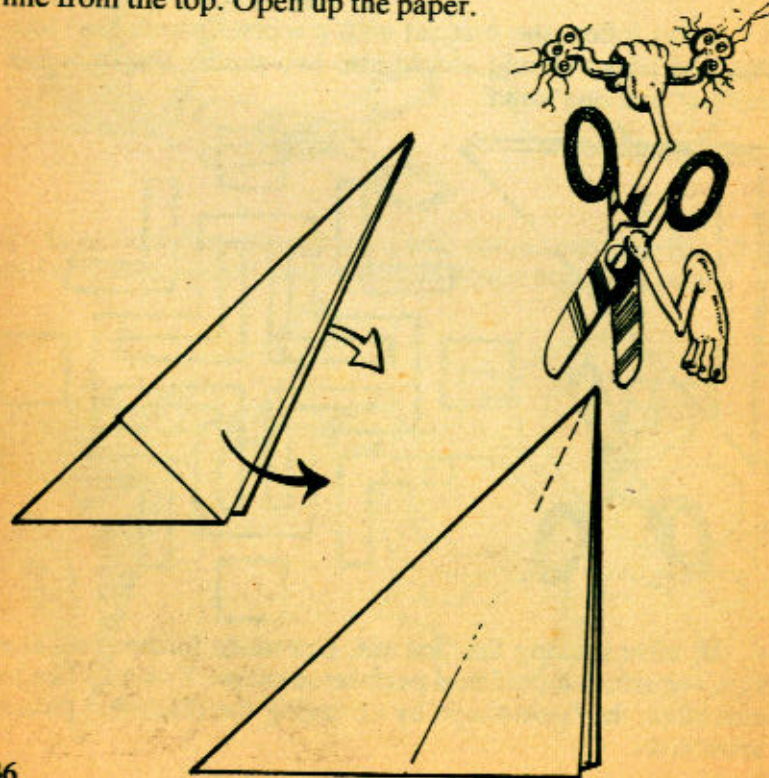
## 'Frame' shapes

By cutting into many of the folded paper squares described above you can achieve, after unfolding, squares with patterned windows which make attractive decorations in their own right or can be used as frames for your drawings or photos.

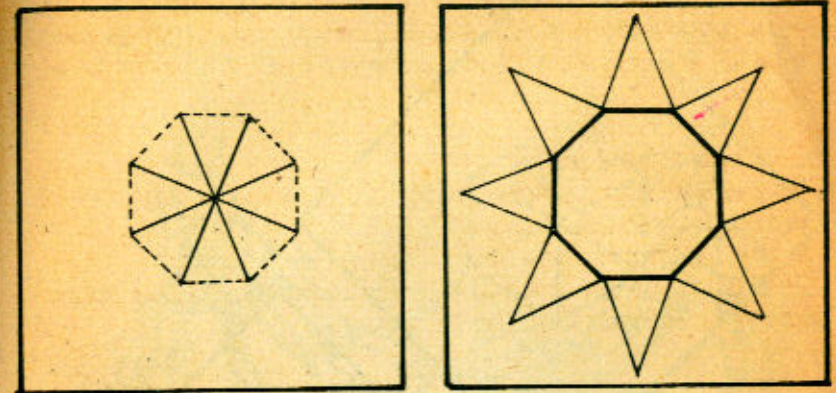
### 1 *Eight-pointed star*

You will need a square of paper. First complete steps 1-4 of the eight-sided figure (page 17).

- 1 Unfold the top and bottom flaps.
- 2 Cut about one-third of the way along the existing crease line from the top. Open up the paper.



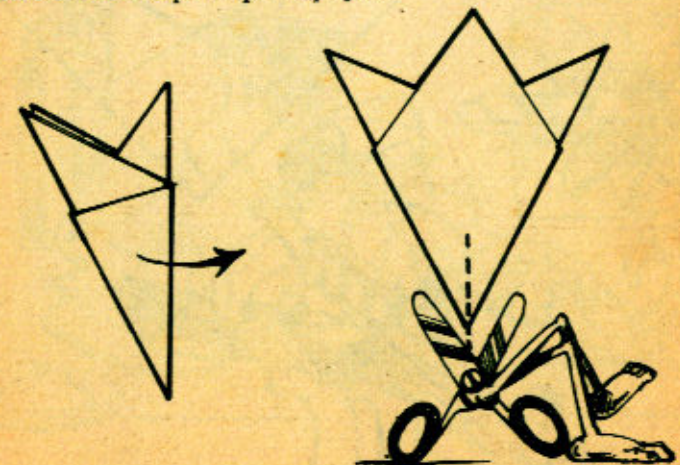
- 3 Fold each of the centre points back as far as it will go.
- 4 The completed eight-pointed star frame.



### 2 *Six-pointed star*

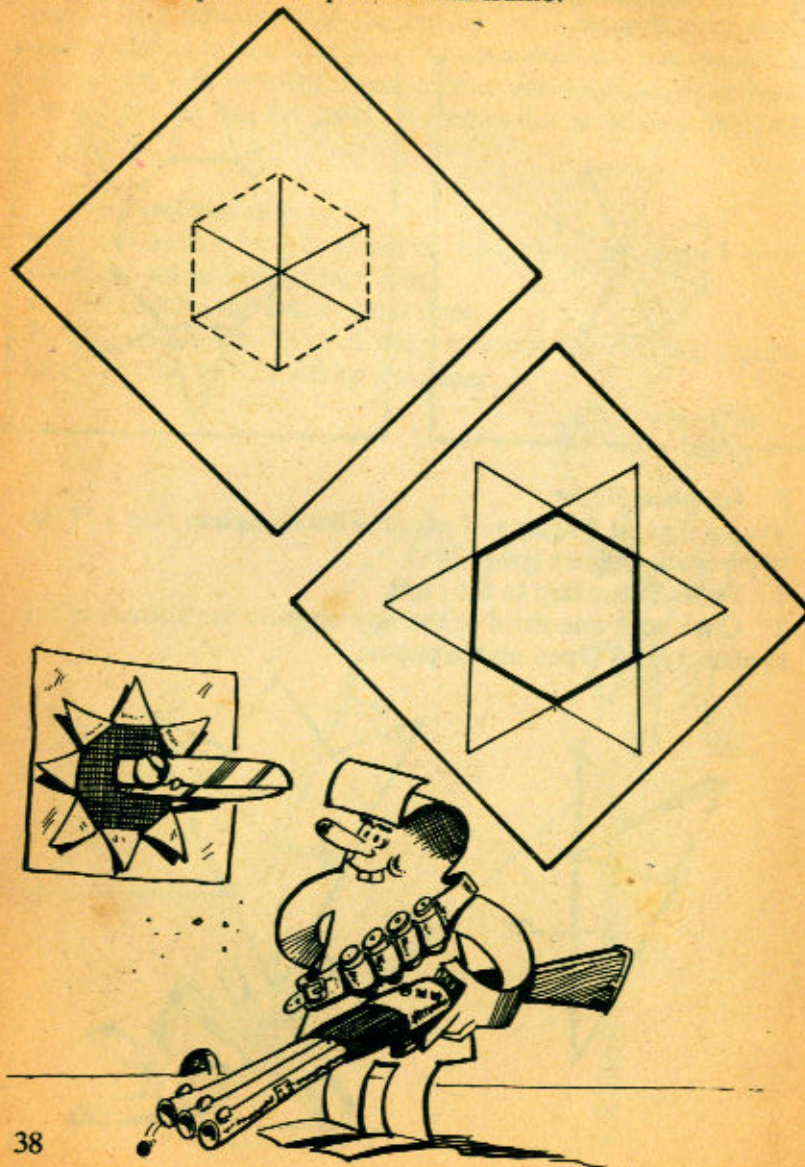
You will need a square of paper. First complete step 1 of the twelve-sided figure (page 24).

- 1 Fold the top flap to the right.
- 2 Cut about one-third of the way up from the bottom of the centre crease. Open up the paper.





- 3 Fold each of the centre flaps back as far as it will go.
- 4 The completed six-pointed star frame.



## Joining Shapes: Patterns and Decorations





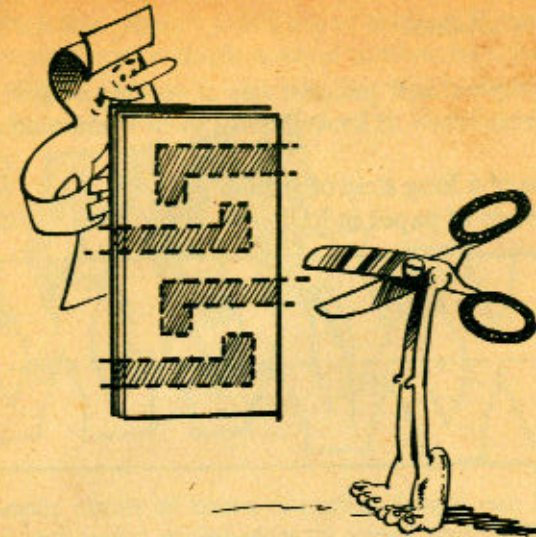
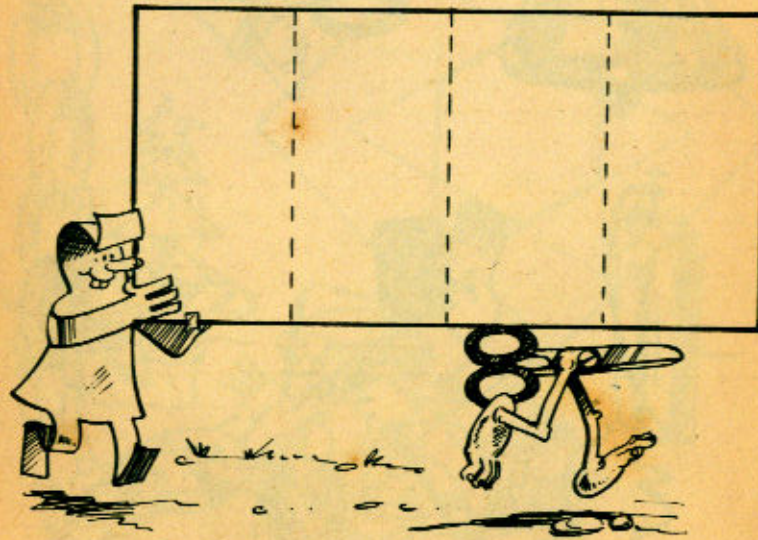
## Frieze

By taking a strip of paper and pleating it backwards and forwards, you can make a square (or rectangle) of many layers. If you draw a shape on the topmost layer, then cut around your drawing through all the layers of paper and finally open it up, you will have made a long pattern which can be used as a frieze, or part of a frieze, to decorate your bedroom wall.

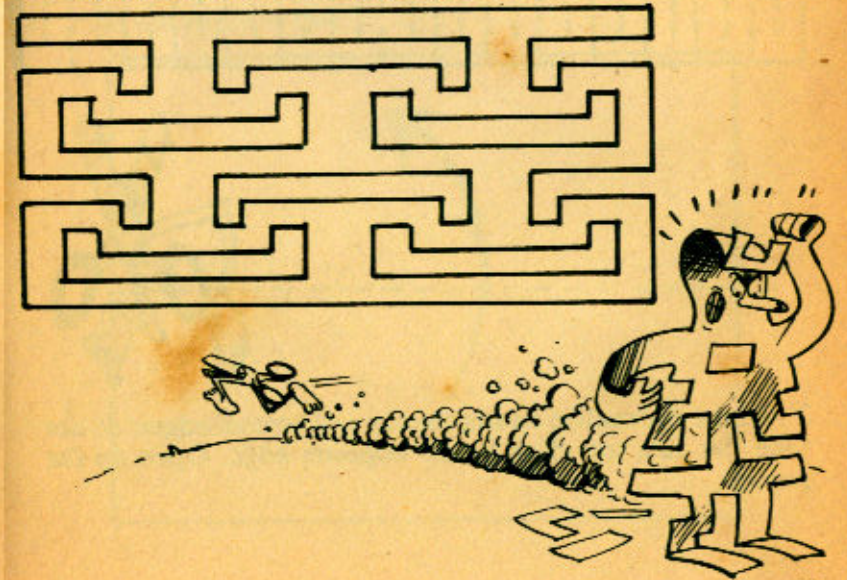
When cutting, you may cut into the folded edge, of course, but you must not cut it *completely* away.

You will need a strip of paper.

1 Fold the paper concertina fashion. It is best to fold the strip in half, then into quarters, then into eighths, etc, so that each layer is made a similar size.



- 2 Draw and cut out your design. Open up the paper.
- 3 One section of the completed frieze.



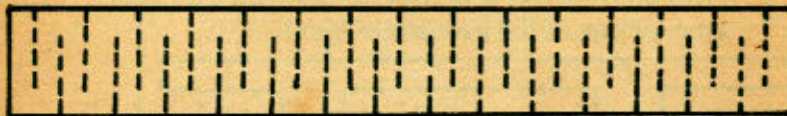
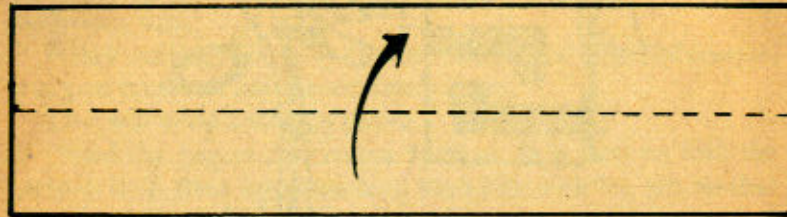


### Simple paper chains

Here is the simplest and quickest way of making a paper chain for a party decoration. It looks festive even when made from newspaper.

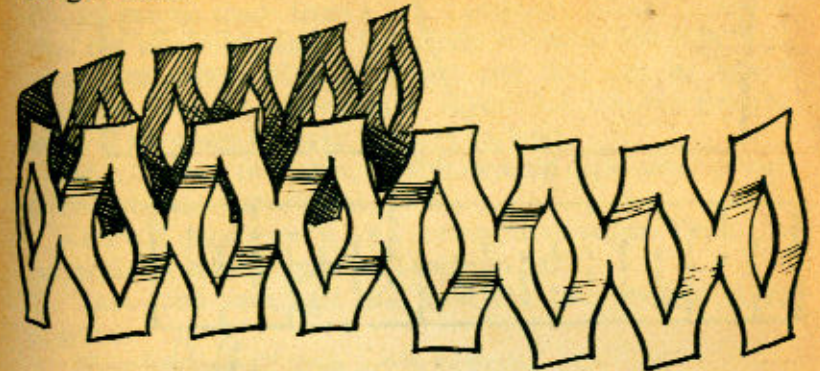
You will need a long strip of paper.

- 1 Fold the strip of paper in half.



- 2 Make alternative cuts in the top and bottom edges; do not take the cuts too close to the opposite edge. Open up the paper.

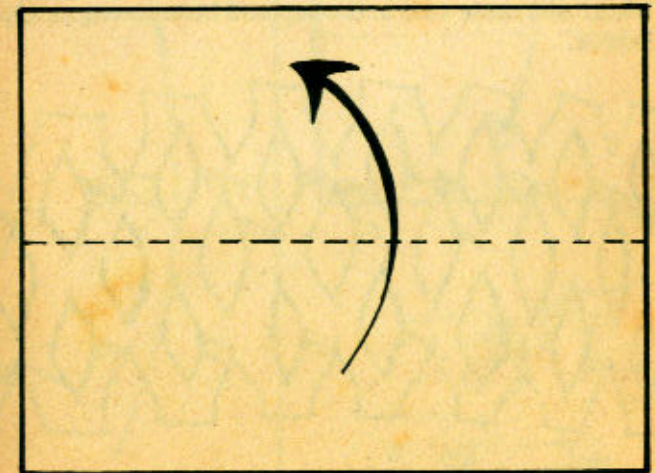
- 3 Stretch the paper by pulling at both ends and this shape will appear. Glue or staple several sections together to make a longer chain.



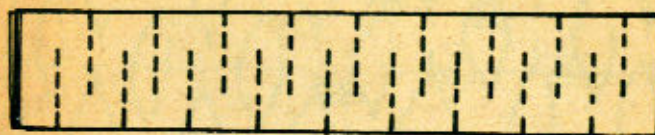
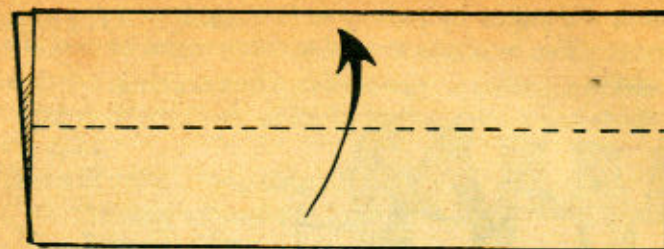
A paper chain of more complex design can be made by using a somewhat wider strip of paper and folding it in half twice.

You will need a long strip of paper.

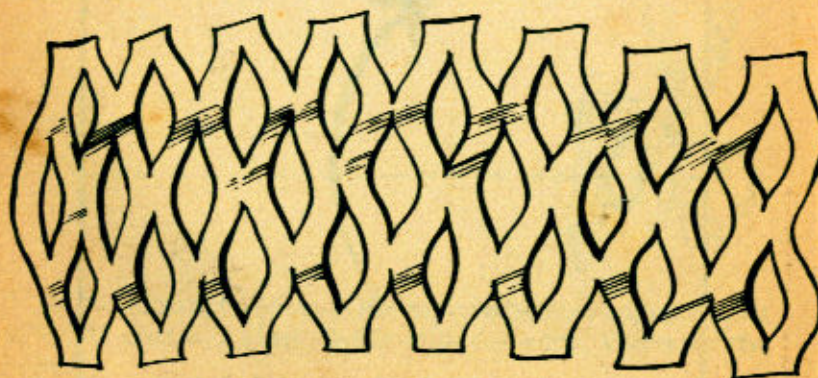
- 1 Fold the paper in half.







- 2 Fold the paper in half again.
- 3 Make alternate cuts in the top and bottom edges. Open up the paper.



- 4 Pull on either end to make this perforated shape. Add more sections to make a chain.

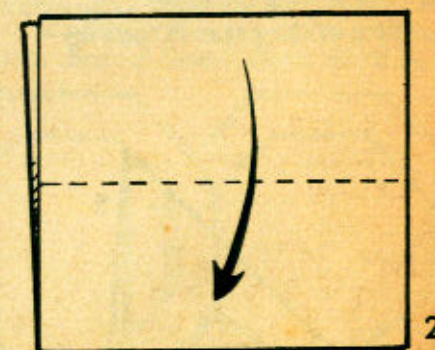
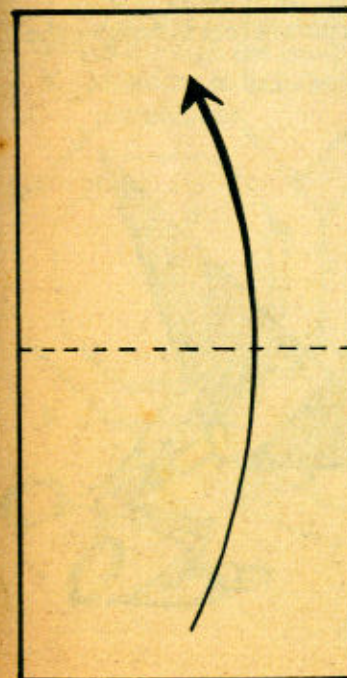
## Paper chains and garlands

Many of the shapes described in 'Making Shapes' (pages 9-38) can be made from a  $2 \times 1$  rectangle folded in half so that the shape consists of two layers joined at one edge. Cut away the centre of such shapes and they can be linked together to make paper chains. If you like, you can join the ends of the chain to make a ring or garland.

Here is a way of making double-layered eight-sided shapes to be used as a paper chain.

You will need several  $2 \times 1$  rectangles of paper. These can be made by cutting squares of paper in half.

- 1 Take one rectangle and fold the two shorter edges together.
- 2 Now fold in half from top to bottom.



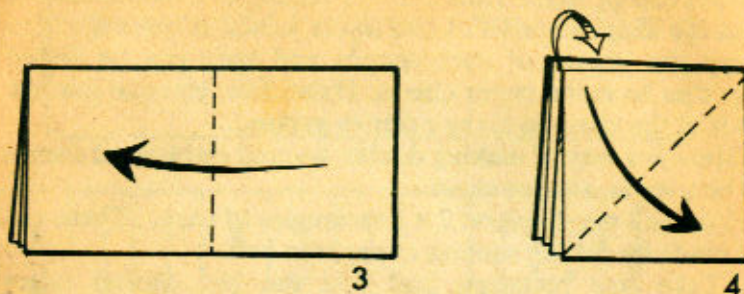
1

2

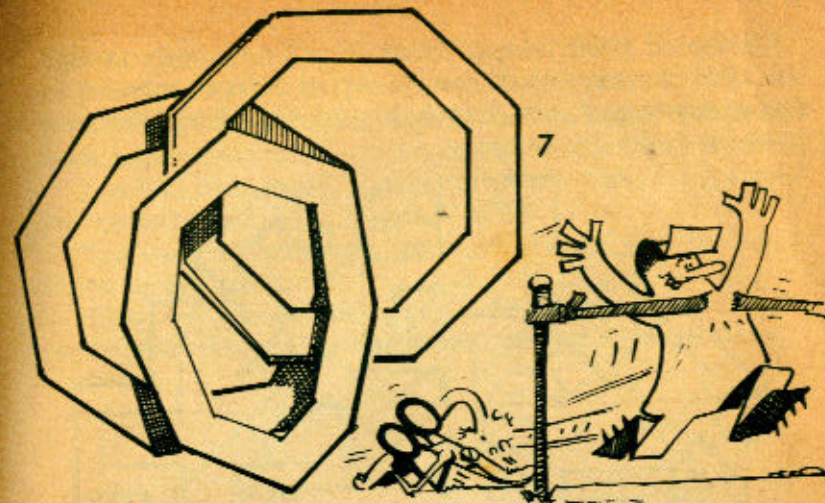
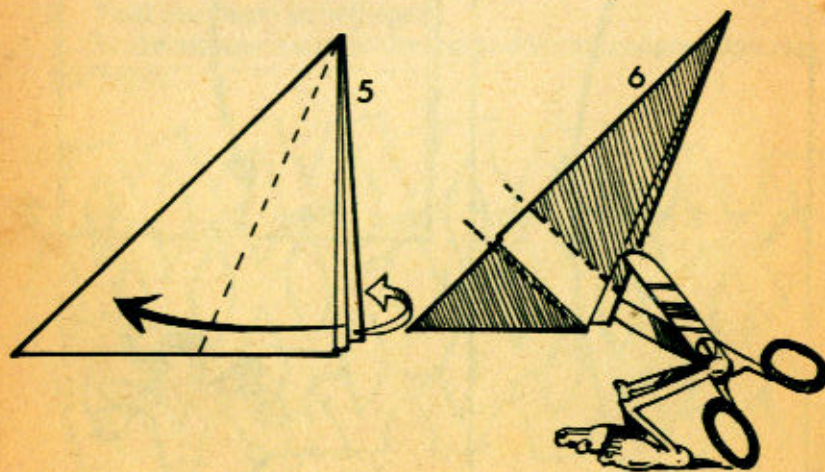




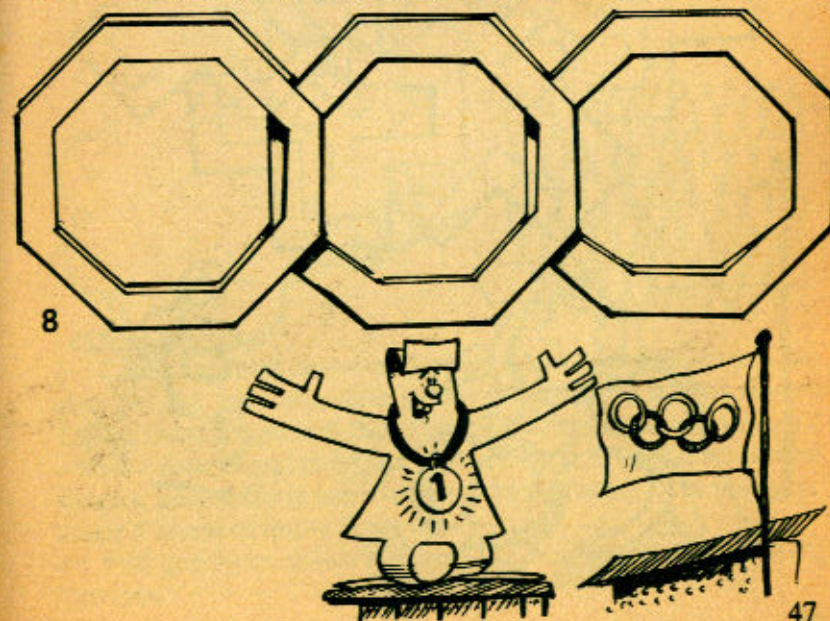
- 3 Fold in half from right to left.
- 4 Fold the top flap diagonally in half. Turn over and do the same behind.



- 5 Fold the vertical edges at right (two layers) to the diagonal edge. Turn over and do the same with the remaining layer.
- 6 Cut along the edge. Then make a parallel cut to remove the centre of the paper. Open up.

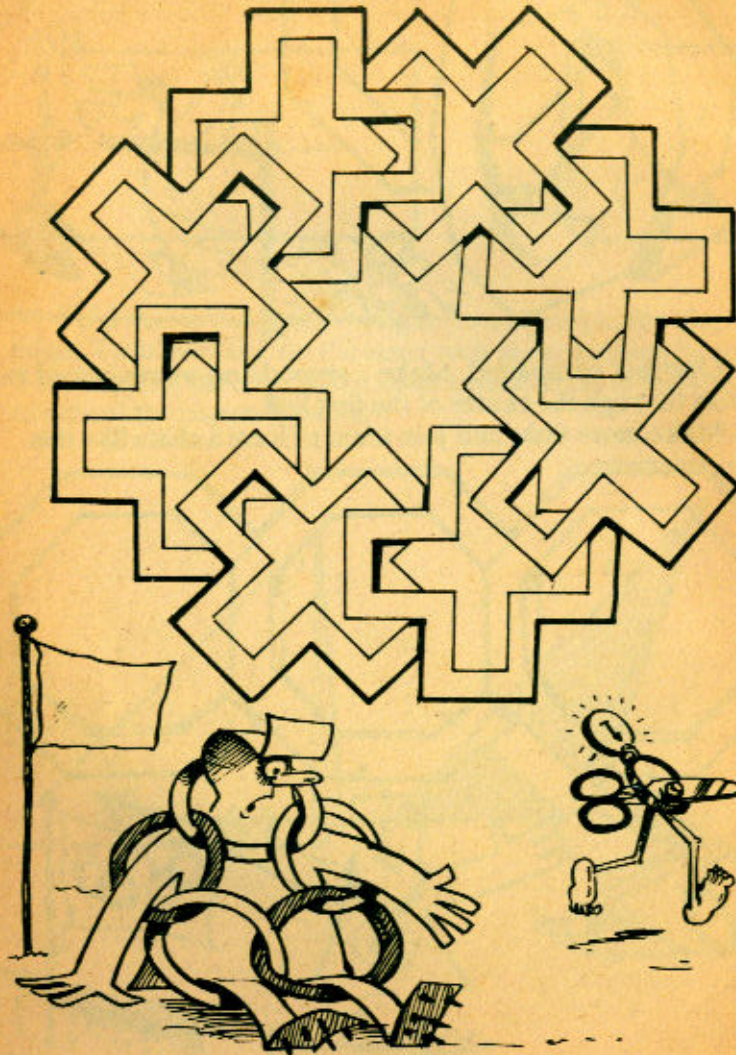


- 7 One link completed. Make a second and weave one of its layers through the centre of the first link.
- 8 Make more links and join them to form a chain like this.





Chains of paper shapes made in a similar way to that described on pages 45-47 can be stapled or taped together to make rings or garlands. Eight hollowed-out crosses have been joined to make this design.

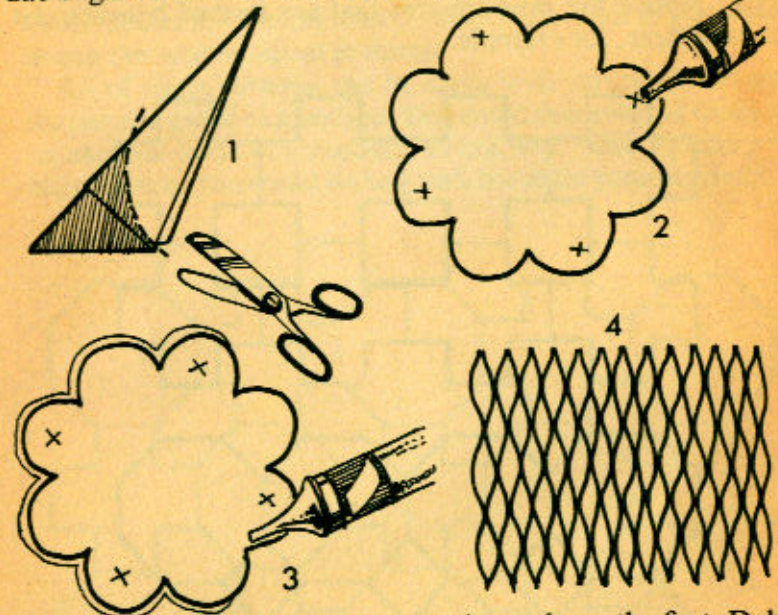


## Flower chains

Flower shapes can be glued together to make paper chains of a kind sometimes known as 'honeycomb' designs.

You will need many squares of paper. Take each square and complete steps 1-4, pages 17 to 18.

- 1 On each folded shape cut a full, curved line as shown. Open up the paper.
- 2 You have made some eight-petalled flower shapes. Place a dab of glue on four alternate petals (marked X) of one shape.



- 3 Take a second shape and place it neatly on the first. Dab glue on the four alternate petals (marked X) of this shape. Take a third shape and glue it to the first two as shown in step 2 - then a fourth and glue it as shown in step 3. Continue adding shapes, gluing them together in alternate ways until you have made a chain of many flowers.

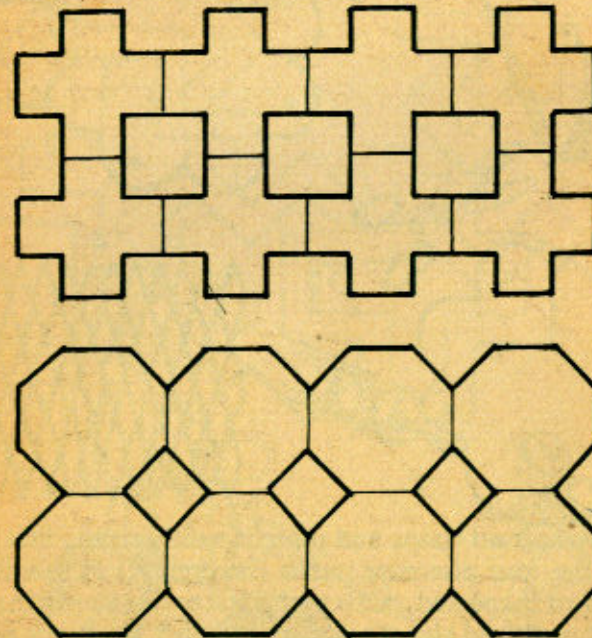
- 4 Pull gently at either end and the flowers will partly open like this.



### Simple repeat patterns

Use the cut-out shapes which you have already learnt to make patterns. The simplest kind of pattern is one in which similar shapes are repeated by being placed edge to edge.

1 Eight crosses (page 15) are placed together in two lines. You can enlarge this pattern by placing more crosses above, below and alongside those already arranged. It is important to notice that, by placing shapes edge to edge like this, you create new unexpected shapes in the areas between the cut-outs. Notice the little squares that are formed between the crosses here, for example.



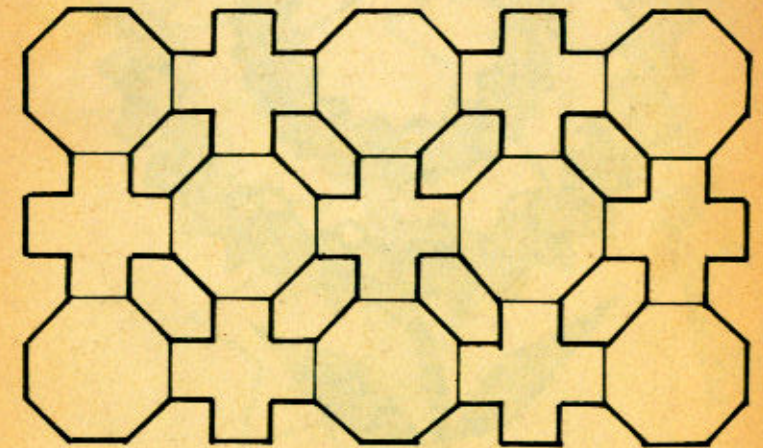
2 Eight six-sided figures (page 22) are placed together in a similar way. Notice that little squares again appear between the cut-out shapes – this time standing on their corners.

### Alternating repeat patterns

It is a bit more interesting to choose two different kinds of shape (let us call them shape A and shape B) and to alternate them – placing first shape A and then shape B in a line; then forming a second line beneath the first, starting with shape B and then shape A and so on.

Place crosses and six-sided shapes together in this way. (Notice that in this case it is lozenge shapes which appear between the cut-outs.) Of course, this pattern can be continued in any direction to cover as big a space as you want, as can the simple repeat patterns.

All of these patterns can be made with very small cut-out shapes and glued to a surface. You could decorate the cover of an exercise book or scrapbook in this way. With a pattern of larger shapes you could make a wall-frieze for your bedroom.

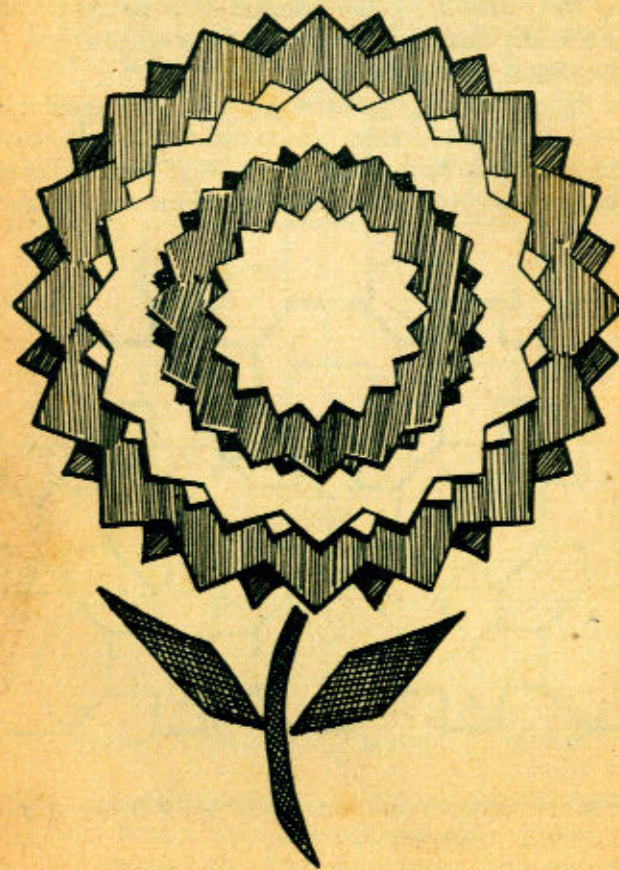




### Radial flower patterns

Basic shapes can be placed one on top of another to make more complex shapes. Note that each shape should have its centre lying on the same point

Try joining star shapes, of different size and various matching colours, to make a flower design like this. A stem can be cut from a scrap of paper and diamond shapes used as the basis for petals.



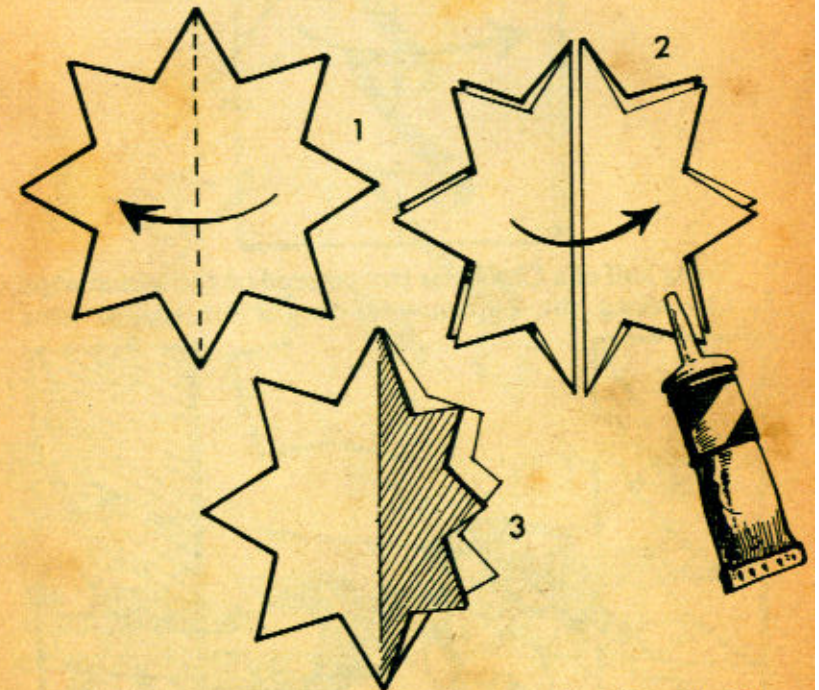
### Three-dimensional star

The shapes described in 'Making Shapes' (pages 9-38) can be joined together to give them the appearance of greater solidity. Hang them by a thread so that they twirl gently in the air presenting a changing appearance to anybody watching them.

The following three-dimensional star is just an example of what you can do. Try it with other shapes as well.

You will need: *two eight-pointed stars (page 20)*  
*glue*

- 1 Fold the stars in half.



- 2 Place them with the folded edges together like this. Glue the two surfaces together.
- 3 Completed.

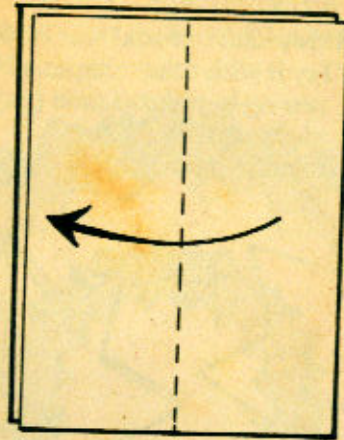


## Standing Christmas tree

You may like to try making standing objects in a similar way.

You will need: *two sheets of paper*  
*pencil, scissors and glue*

- 1 Fold the two sheets of paper in half from right to left.



- 2 Draw half of a Christmas tree centred on the folded edge.
- 3 Cut along the outline and discard the shaded area.



Separate the two Christmas tree shapes and glue them together in the same way as the star on page 53. If you repeat this process with two more sheets of paper, and glue the two structures back to back, you will have a stronger tree with four sets of 'branches' instead of three.



- 4 The tree completed. Try decorating it with a little three-dimensional star and similarly made hanging ornaments.

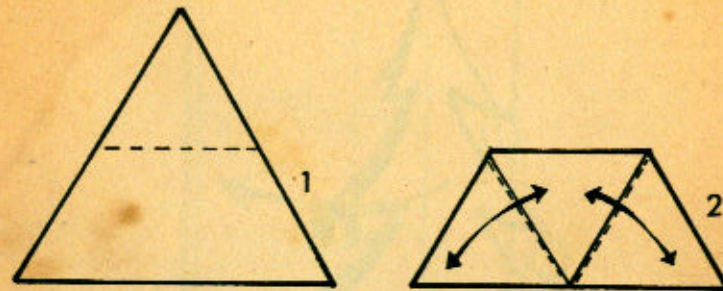


## Joining shapes to make solids

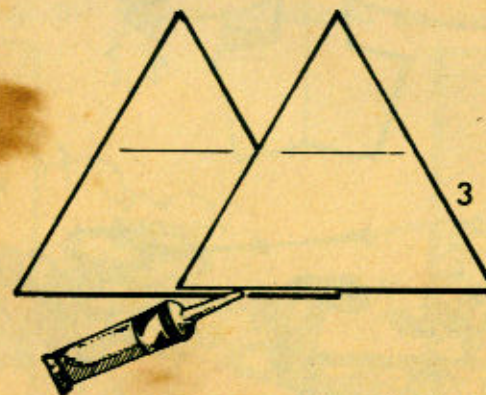
### 1 Container

You will need: *three equilateral paper triangles (page 13)*  
glue

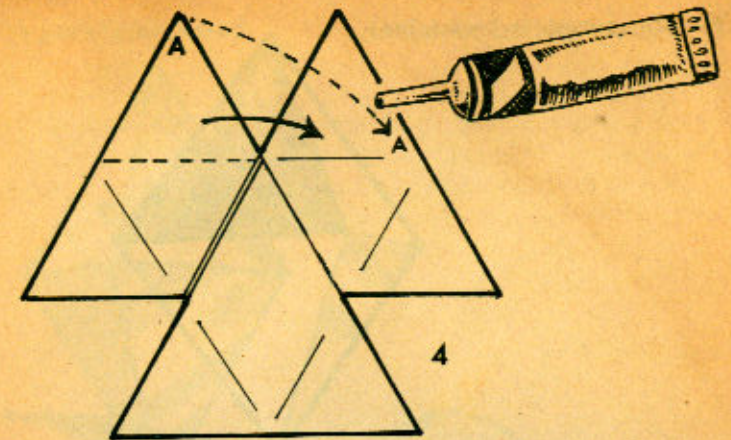
1 Take one triangle and fold the top point to the centre of the bottom edge.



2 Fold the bottom corners across the central triangle in turn, make creases and open up. Repeat steps 1-2 with the remaining two paper triangles.

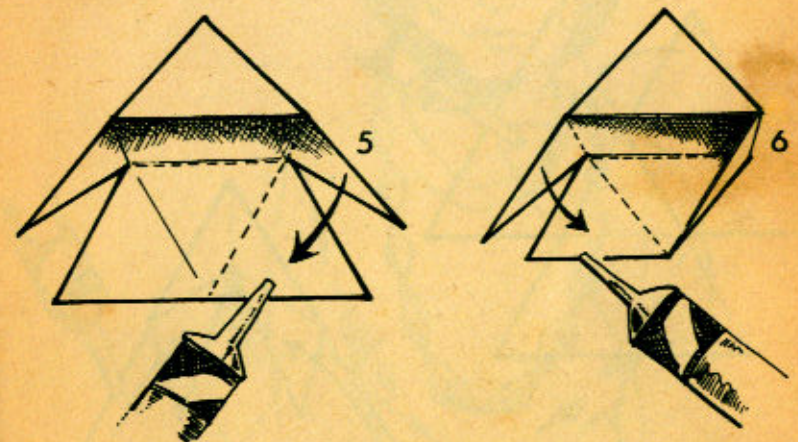


3 Overlap the corner triangular areas of two triangles. Glue together; then glue the third triangle in position . . .



4 . . . like this. Here is a useful basic shape which can be folded in several ways to make raised or solid forms.

To make a container, take the top left triangular area to the right so that the corners marked A are one on top of the other, and glue.

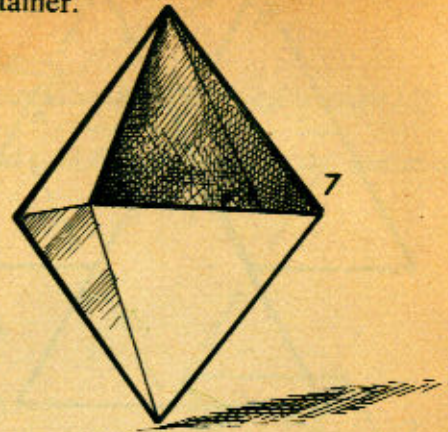


5 Bring the right triangular area down and glue.

6 Bring the left triangular area down and glue. Turn over.



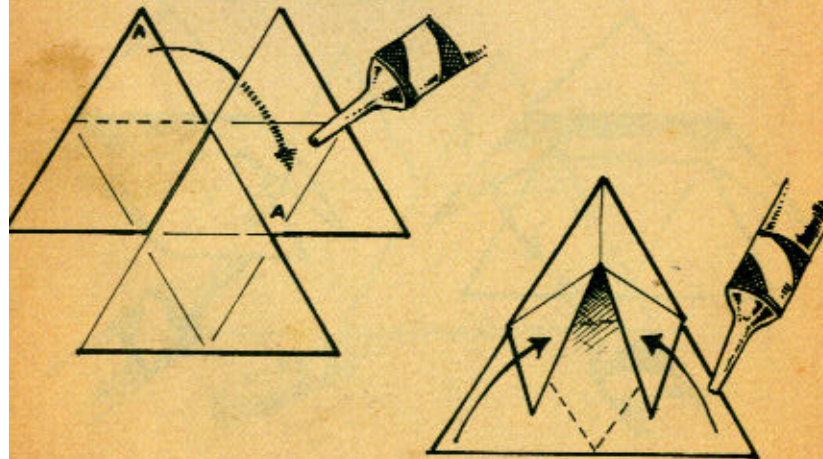
7 The completed container.



## 2 Jewel and Necklace

Use brightly coloured paper or metal foil if you can. Start by completing the basic shape as shown on page 57, but for the fold, go to step 1 below.

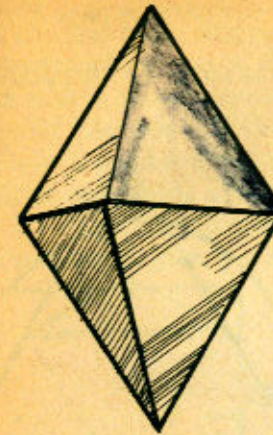
1 Fold the top left triangle down to the right so that the corners marked A are one on top of the other, and glue.



2 Fold the two bottom corner triangles up in turn and glue to the flaps.

58

3 A jewel completed.



4 String several jewels together with needle and thread to make a necklace.

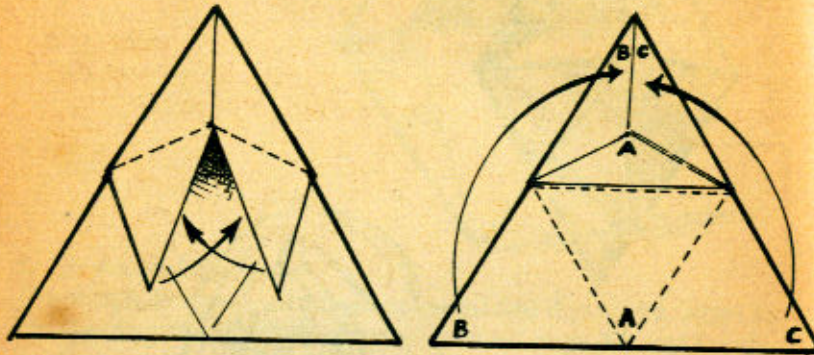
59



### 3 Pyramid

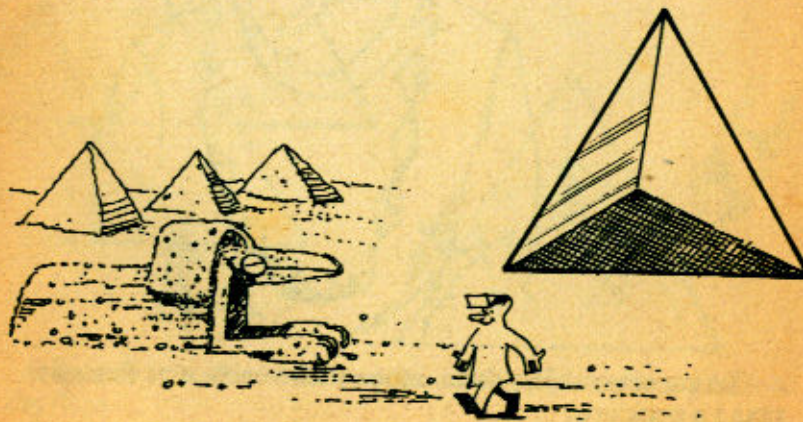
Start by completing the basic shape as shown on page 57; then complete step 1 of the jewel (page 58).

1 Fold the two triangular flaps up to close the hole and glue together.



2 Bring the bottom section up and glue the corners to the sides so that the corners marked A, B, C are together.

3 The completed pyramid. As the above three shapes all have similar triangles for faces, they can be joined together in various ways to make interesting new shapes. See what you can build from them.

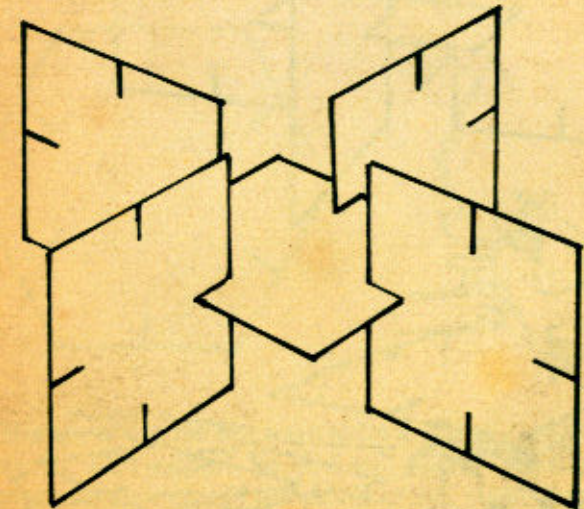
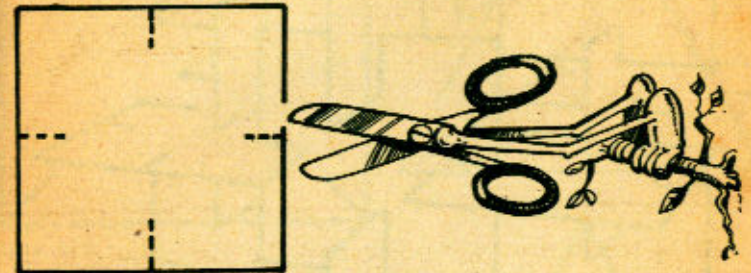


### Shapes into sculpture

You can use basic shapes as units for building into standing structures which can be developed in interesting ways. Build them into a simple tower, for example – or join shapes at irregular intervals to make more unusual constructions.

You will need lots of squares of thin card.

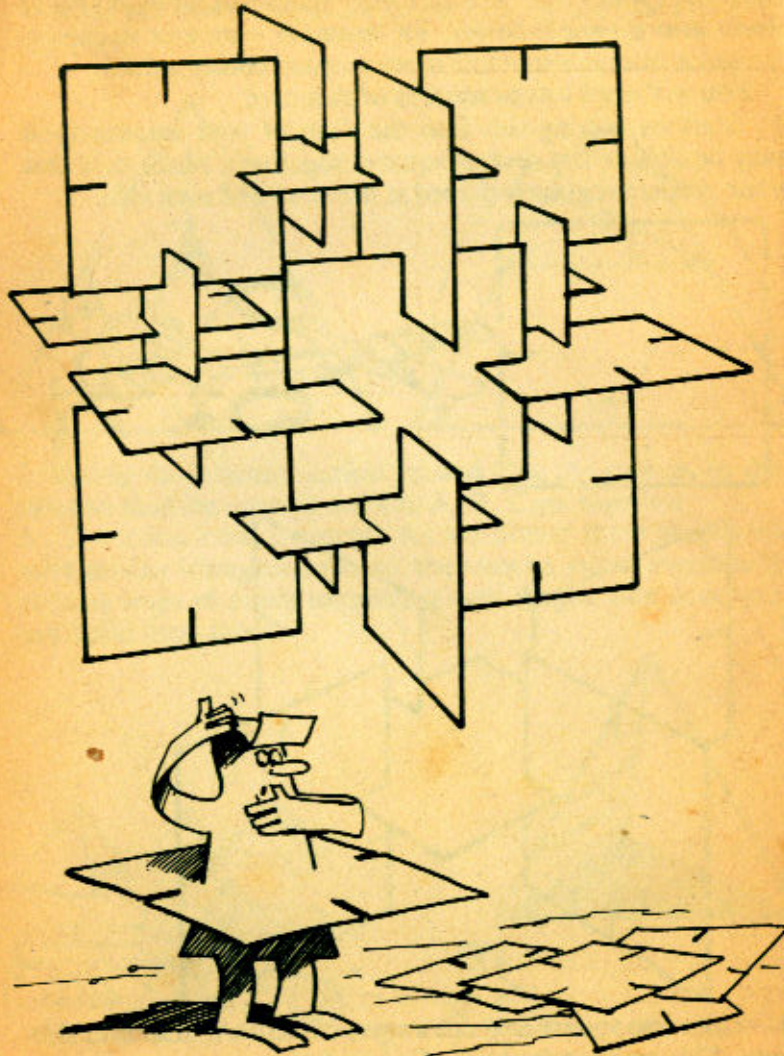
1 Start by cutting slits into the sides of your squares (you may be able to cut several squares together). Make sure that your cuts are regularly placed at the centre of each side.



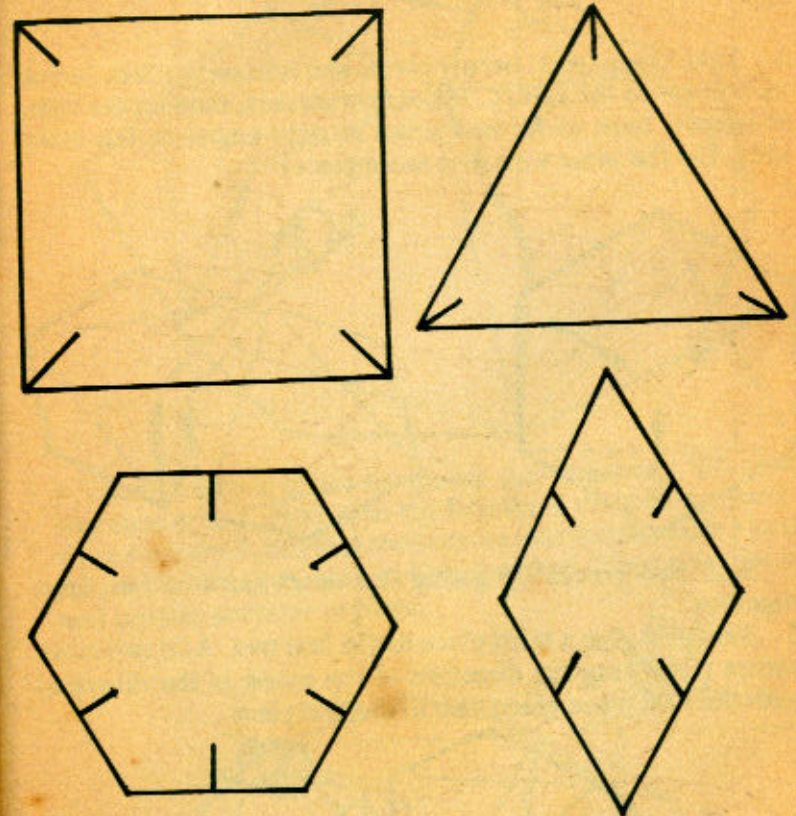
2 Take one square and slot a square into each of its four side cuts. This makes a firm base for building on . . .



3 . . . like this. Eighteen little squares were used to make this structure. Use it as a starting point for developing into a piece of sculpture of your own design.



Try making sculptures by joining squares which have slits cut into their corners instead of their sides. You can also try joining shapes other than squares – and combining sets of two different shapes, or shapes with slits in both their sides and corners. Here are some examples.



Shapes which do not have sides at  $90^\circ$  to each other will not have  $90^\circ$  slits either. So you will find that sculptures made from these shapes will not develop into straight up-and-down towers, as happens when squares are used, but into interesting curved patterns.

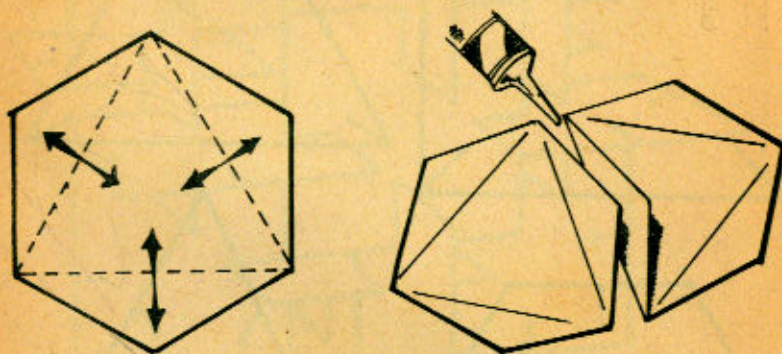


## Twenty-piece ball

Some modern lampshades are made in a similar way to this.

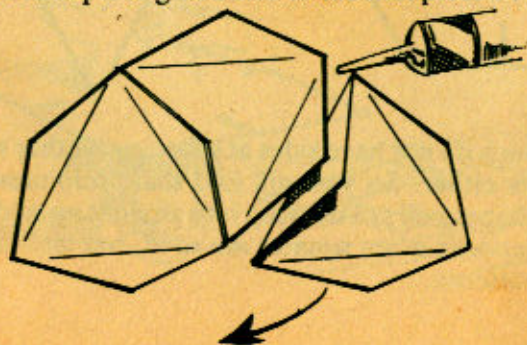
You will need: *twenty six-sided figures (as shown on page 22)*  
*glue*

1 Take one of your twenty pieces and fold every other one of its corners to the centre. Make firm creases, then let the little triangular flaps so formed stand at right-angles to the main area. Do the same with four more pieces.

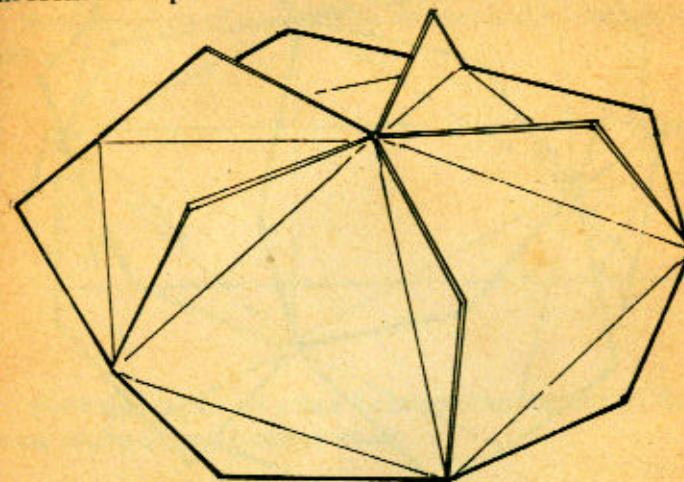


2 Join two pieces by gluing the outer sides of two flaps together.

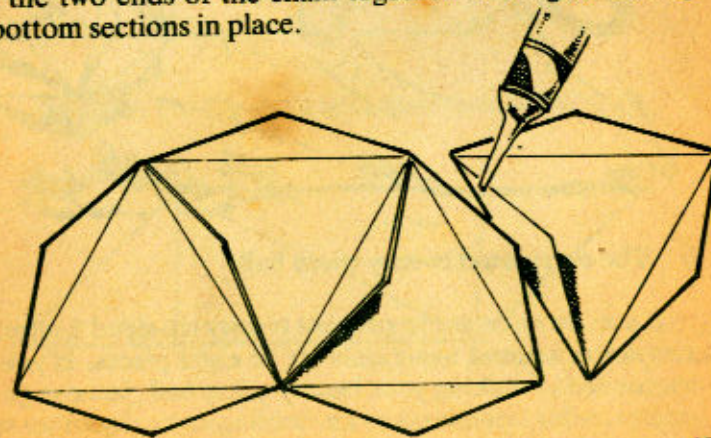
3 Similarly glue a third piece to the first two. Add two more pieces (following the direction of the arrow in the diagram) with the fifth piece glued also to the first piece . . .



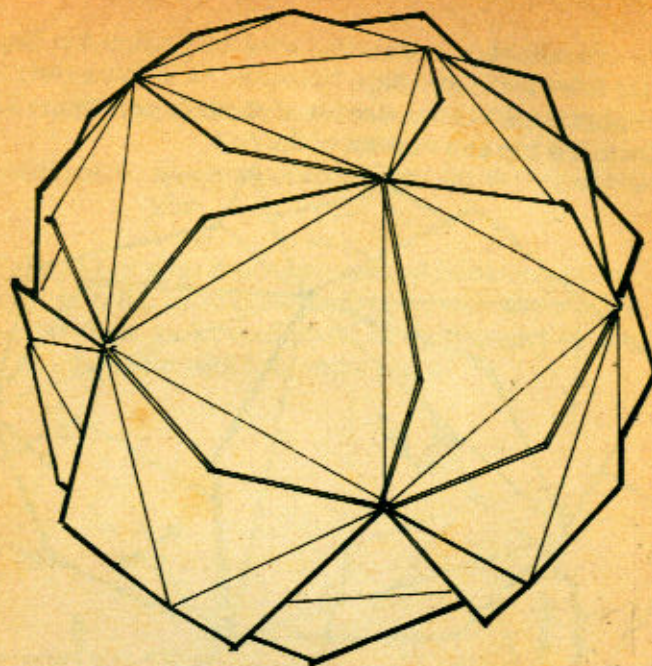
4 . . . to complete a standing structure which has five triangular sides with little flaps between. Take five more pieces and repeat steps 1-3 to make another similar structure. These will form the top and bottom of the ball.



5 Now make a chain by gluing the remaining ten pieces together in line. Note that the first three pieces are joined as shown in step 3, but that the fourth piece is differently placed. Glue the two ends of the chain together. Then glue the top and bottom sections in place.







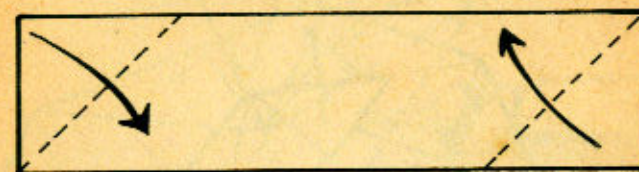
6 The completed twenty-piece ball.

If you do not want to prepare twenty six-sided figures, try a simpler ornament using only six or eight pieces. If you have succeeded in making your twenty-piece ball, you can go on to make similar ornaments by assembling units of another shape.

### 'Woven' ball

You will need lots of  $1 \times 4$  strips of paper (about  $2\text{cm} \times 8\text{cm}$  is a convenient size).

1 Fold the ends of one strip to the top and bottom edges as shown.



2 Fold the paper on a line between the corners of the two flaps, make a crease and open up . . .

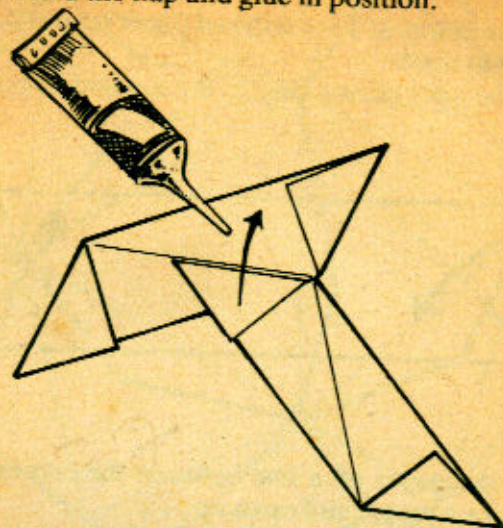


3 . . . like this. Do the same with two more strips.

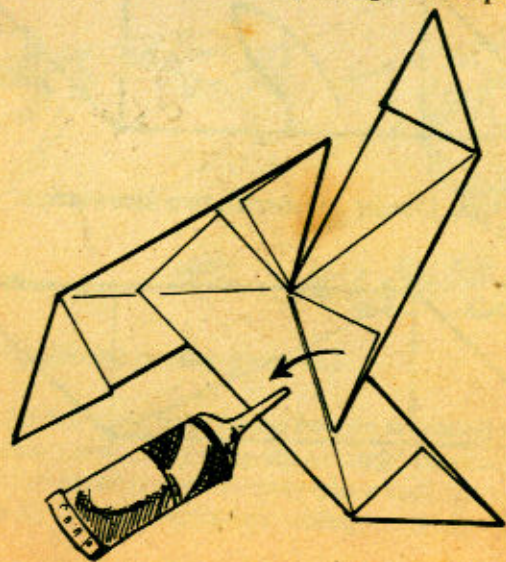




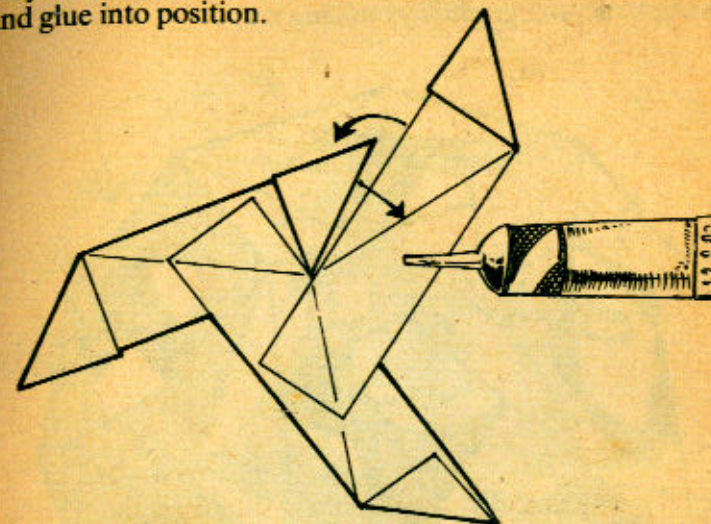
- 4 Bring the folded edge of one strip to the central crease of another. Unfold the flap and glue in position.



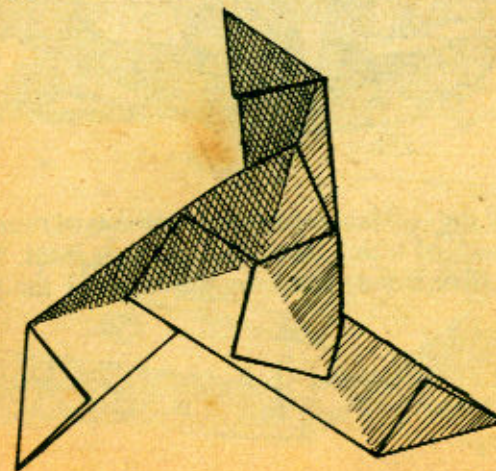
- 5 Now bring the folded edge of the third strip to the crease of the second strip. Unfold the flap and glue into position.



- 6 Bring the folded edge of the first strip to the crease of the third strip. This will have the effect of raising the strips so that they form a shallow 'dish' where they cross. Unfold the flap and glue into position.

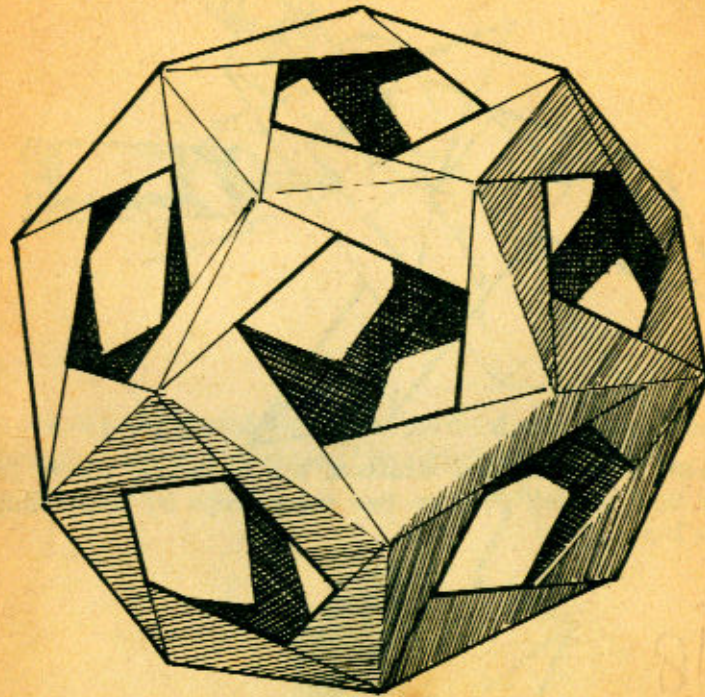


- 7 This three-cornered structure will form one corner of your final model. Prepare two more strips by completing steps 1-3 . . .





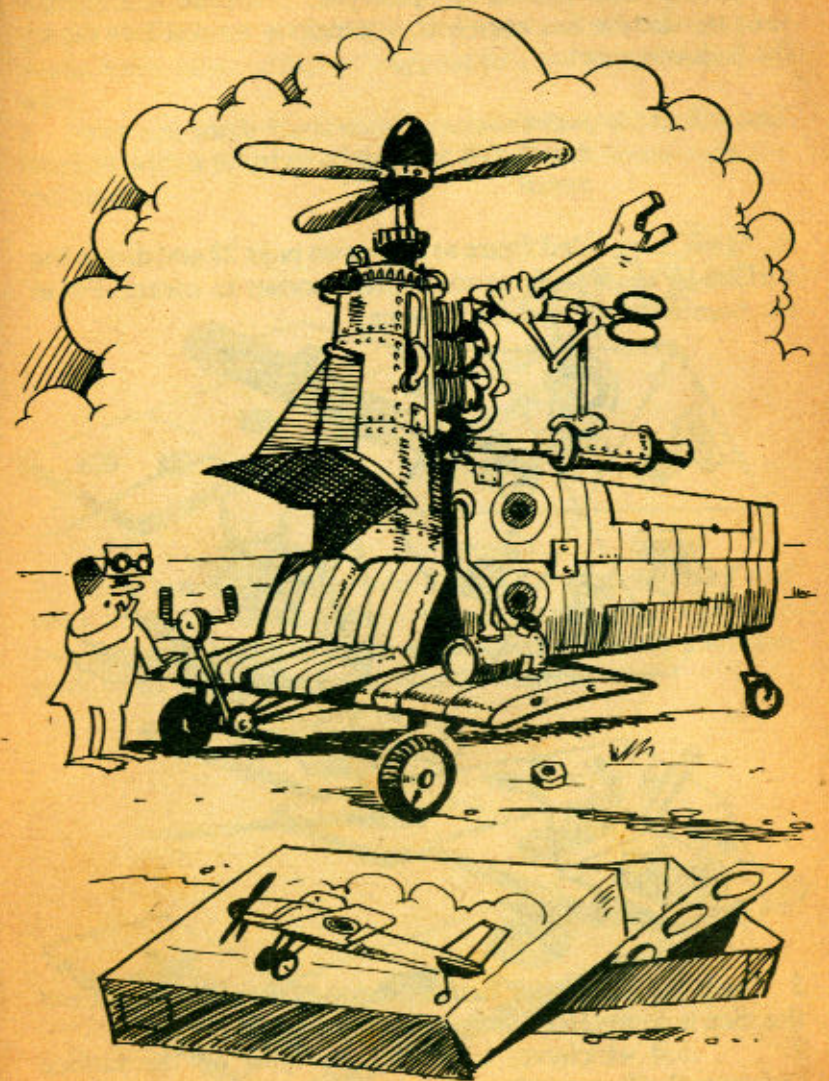
8 . . . and join them to one of the arms in the same way as shown in steps 4-6. This completes a second corner. Prepare more strips and join them similarly to other arms of the growing structure, gradually building it up . . .



9 . . . until the ball is completed. It consists of twenty similar corners in each of which three folded edges meet. Notice the pentagonal (five-sided) windows which cover the surface of the ball.

Try making a similar ball from  $1 \times 5$  strips (about  $2\text{cm} \times 10\text{cm}$ ) and you will find it has some windows of a different shape.

## Changing Shapes: Toys and Puzzles



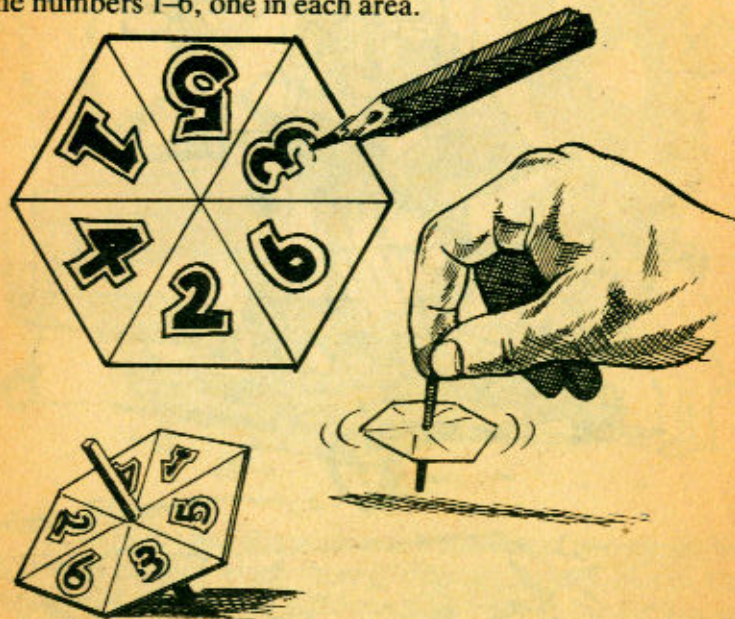


## Spinning dice

If you find that you cannot play your favourite boardgame because the die has been lost, try making a substitute die in the following way.

You will need: *paper*  
*matchstick*  
*pencil*

1 Make a six-sided figure as shown on page 22 and divide the surface by drawing lines across from corner to corner. Fill in the numbers 1-6, one in each area.

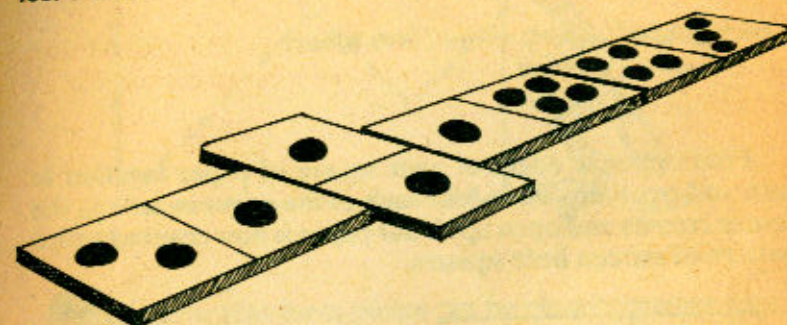


2 Push the matchstick halfway through the centre point and the dice is completed. Spin it on a flat surface . . .  
3 . . . and whichever edge ends up lying on the surface indicates the face number.

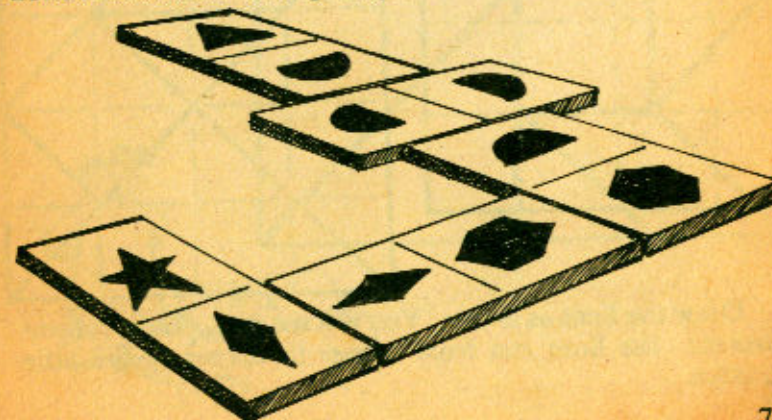
## Dominoes

Very small shapes, of the sort described in 'Making Shapes' (pages 9-38), can be used to decorate a set of dominoes, made from card, which will appeal to a younger brother or sister.

1 Here are some traditional dominoes in which pieces are marked with a number of spots at either end. Some ends are left blank.



2 Here are dominoes made from  $2 \times 1$  rectangles of card with coloured shapes glued to each end. You will need twenty-eight pieces to make a set, decorated with combinations of six different shapes, plus the blanks.



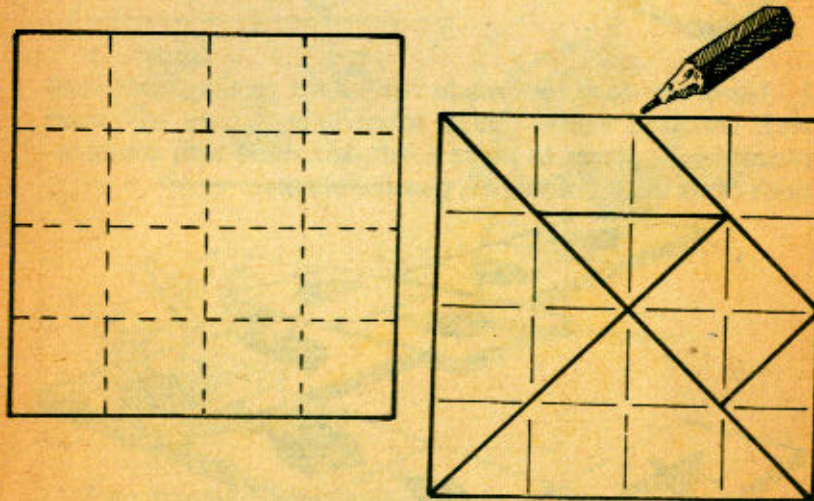


## Tangrams

This is a traditional puzzle which can be enjoyed again and again. A set is made up of seven geometrical shapes – two big triangles, two little triangles, a medium triangle, a square and a parallelogram. With these seven shapes it is possible to make a surprising number of different designs, a few of which are shown on the following pages – but first let us make a tangram set.

You will need: *paper about 10cm square*  
*pencil*  
*scissors*

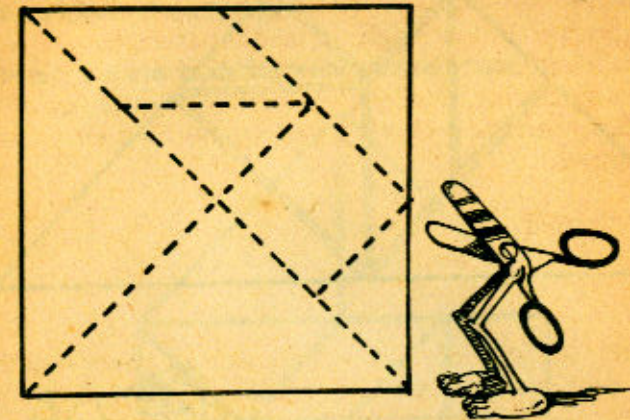
1 Fold opposite edges of your square of paper together in turn and open up. Then fold each of the edges in turn to the centre creases and open up. Your paper is now covered with a pattern of sixteen little squares.



2 Draw the lines as shown. You will see that, except for one instance, the lines run from corner to corner of the little squares.

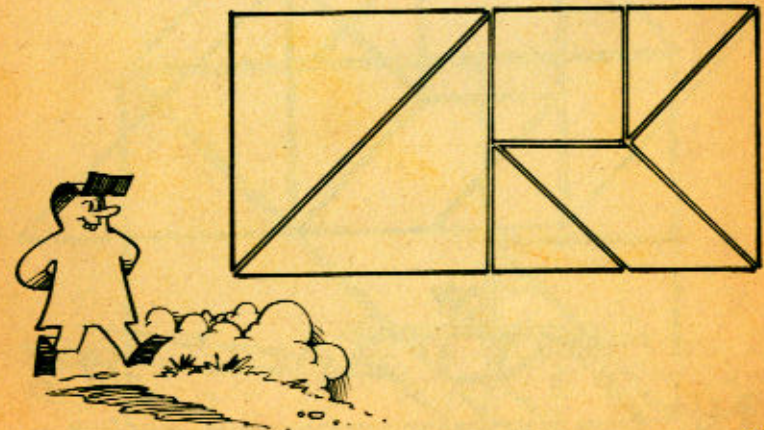
74

3 Cut along the lines you have drawn to make the seven tangram pieces.



You know that these pieces can be placed together edge to edge to form a square. Can you arrange them all to form a triangle or a rectangle or a parallelogram?

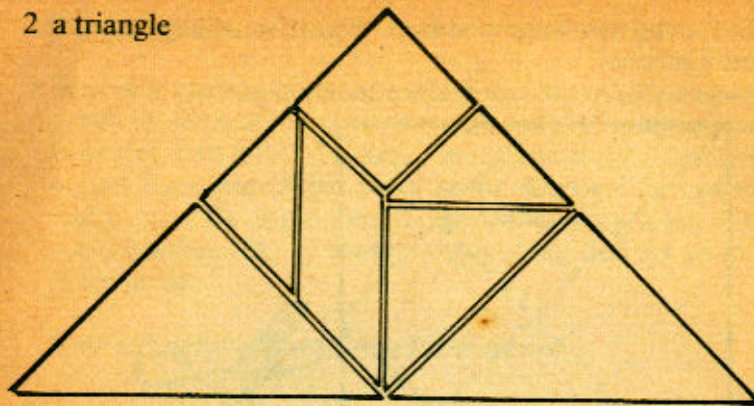
Here is: 1 a rectangle



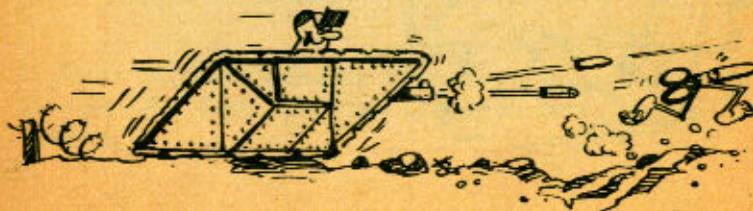
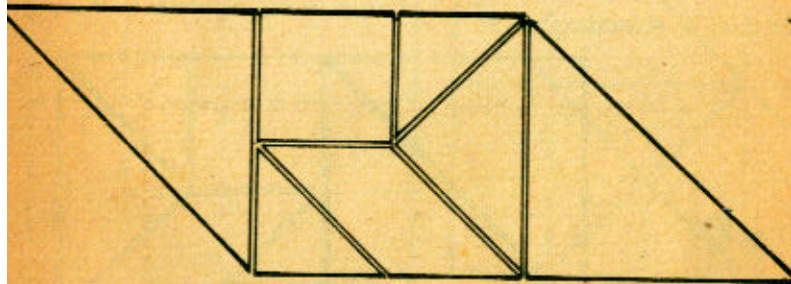
75



2 a triangle



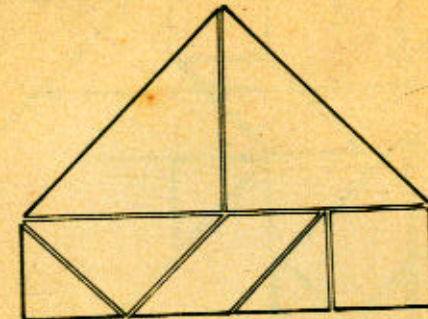
3 a parallelogram



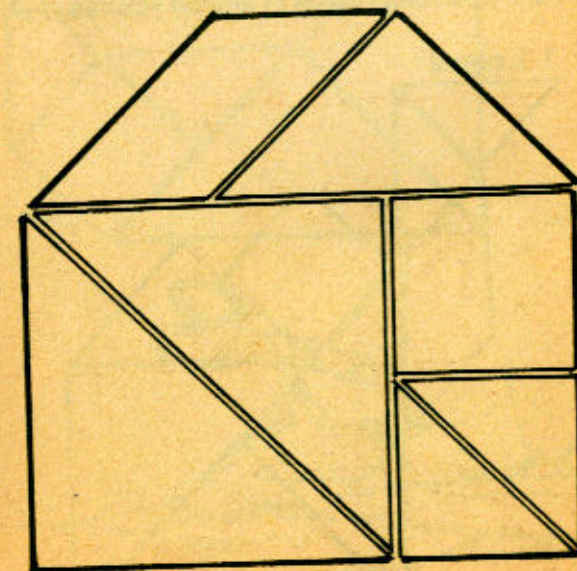
You may have found other ways of reaching the same result.

Now try arranging your set of tangram pieces to represent various kinds of buildings.

Here is: 1 a low building with a sloping roof

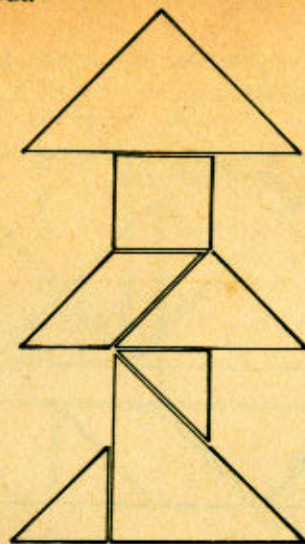


2 a higher building



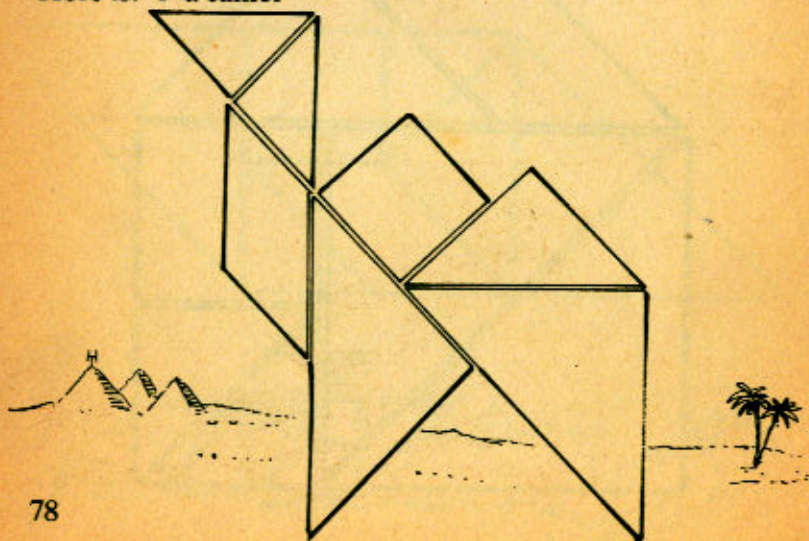


3 a Chinese pagoda

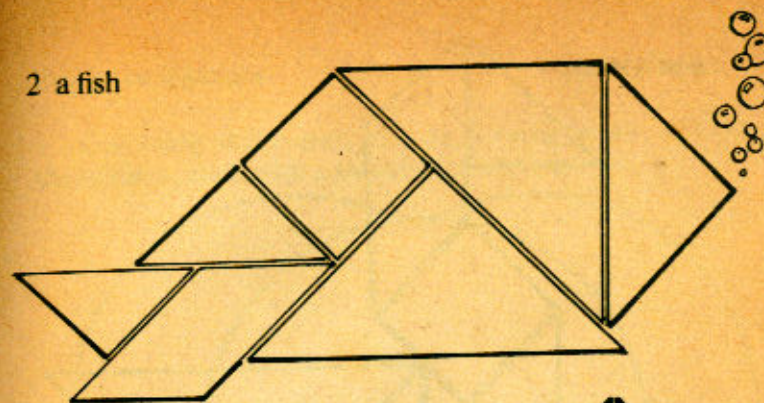


Perhaps you succeeded in making some other kind of building. Now see how many kinds of animal you can make.

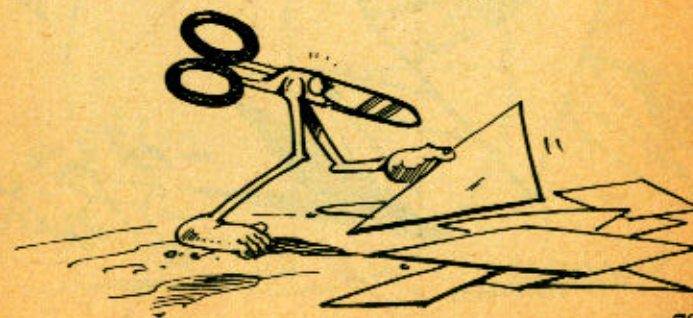
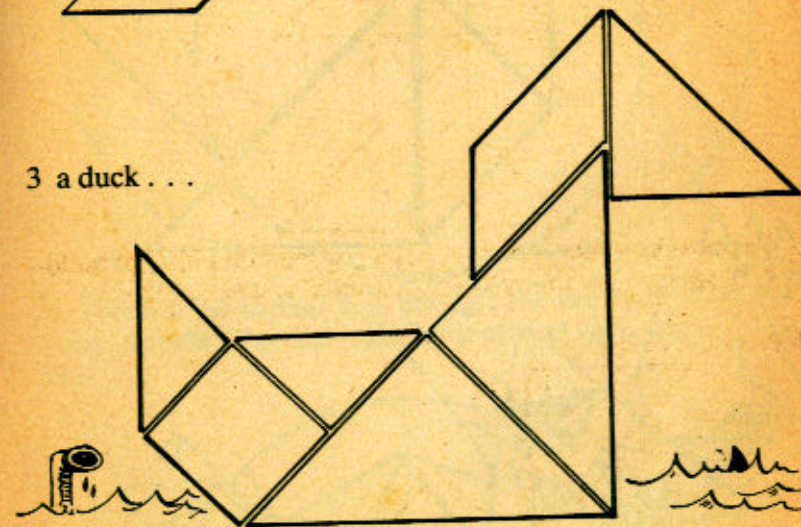
Here is: 1 a camel



2 a fish

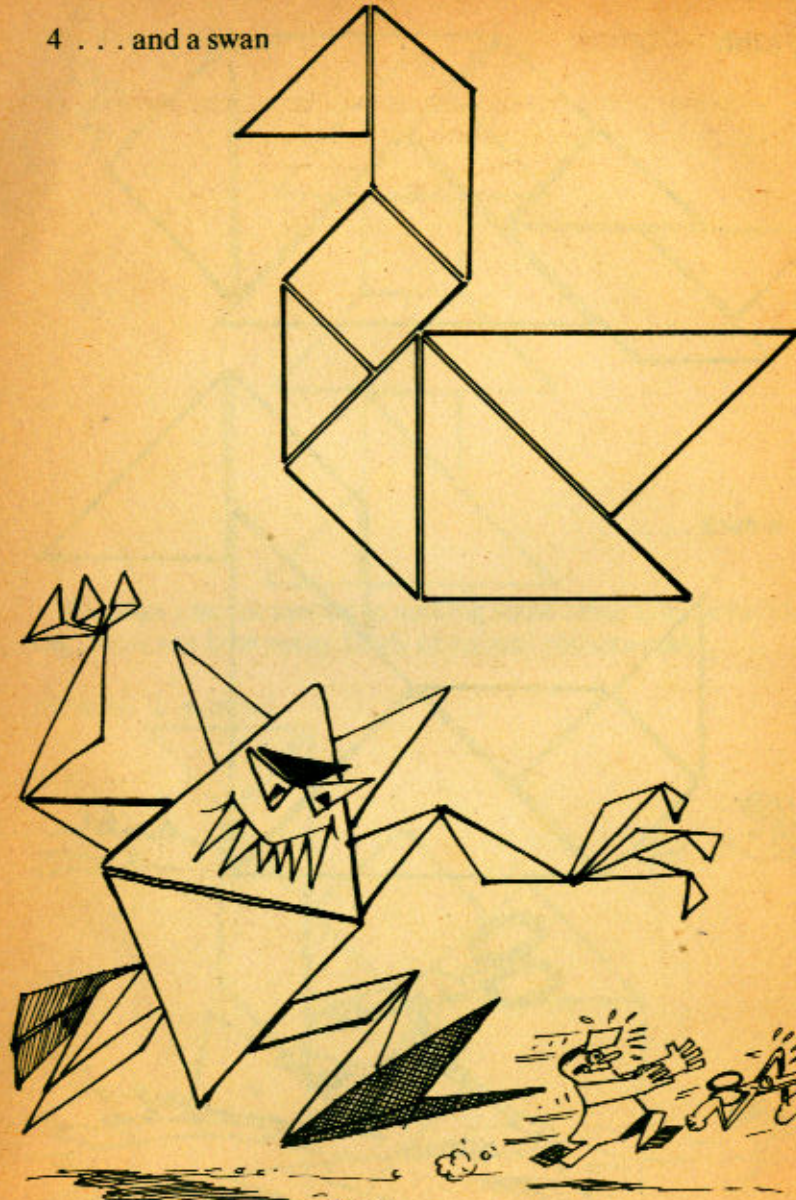


3 a duck . . .



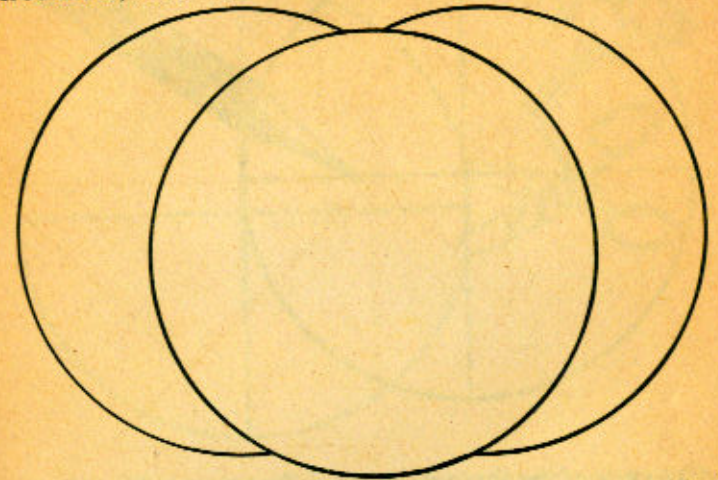


4 . . . and a swan

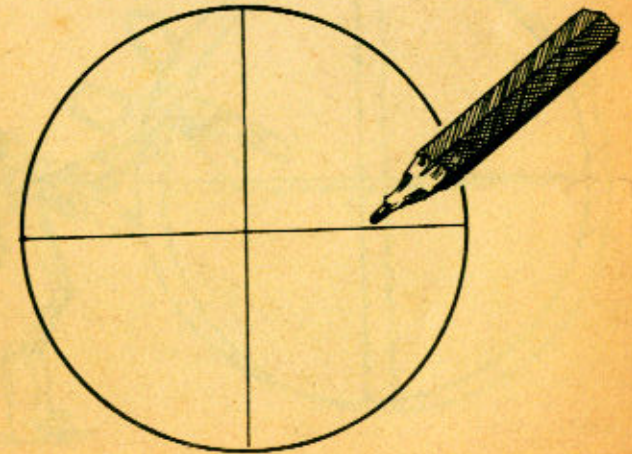


### Paper ball puzzle

1 Use fairly stiff paper, such as drawing paper, and cut out three discs, each with a radius of about 5cm.

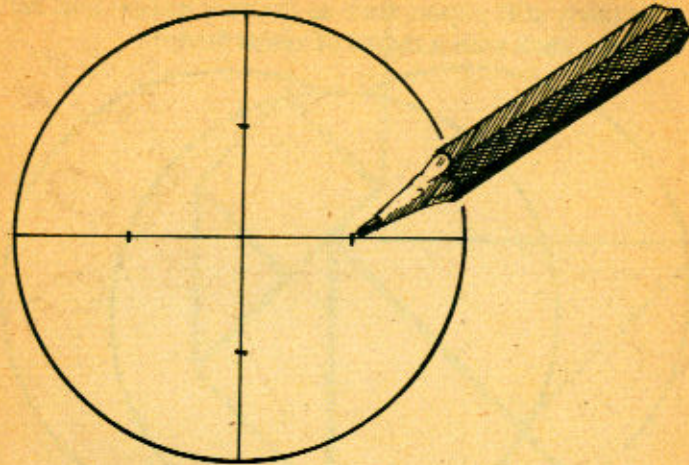


2 Draw a horizontal line through the centre of each disc. Draw another line through the centre at right angles to the first.

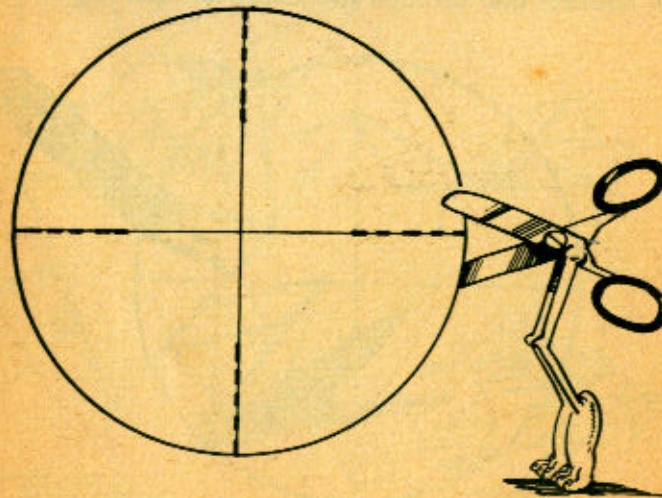




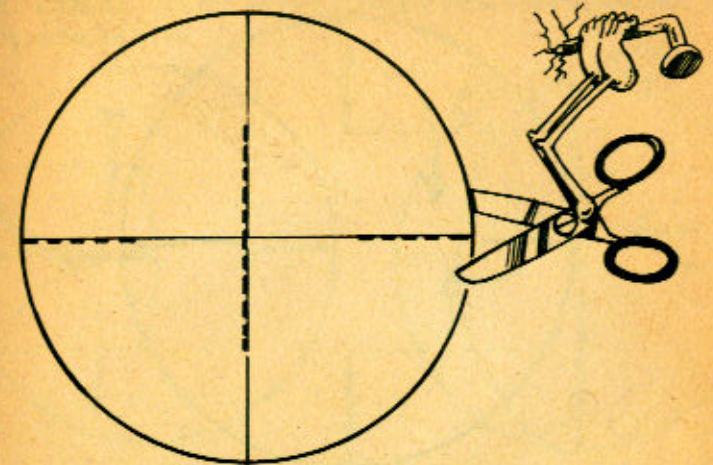
3 Find the centre of each of the four radial lines.



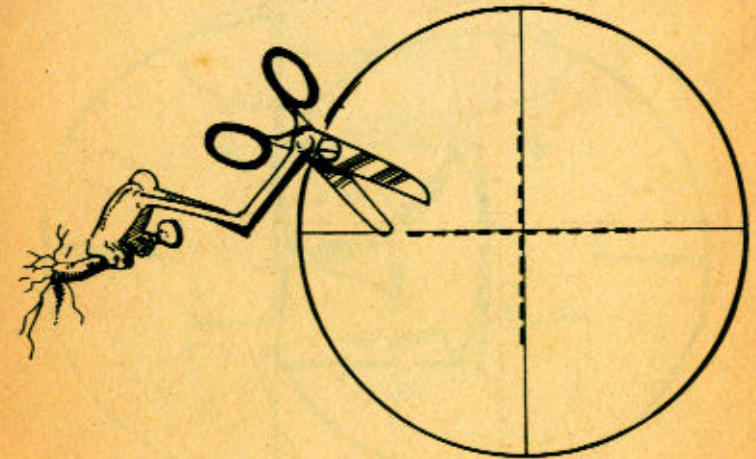
4 Cut each of the three discs in a different way. First disc: cut along each line from the outer edge to the halfway mark.



5 Second disc: cut the horizontal line from the outer edge to the two halfway marks. Cut the vertical line between the halfway marks.

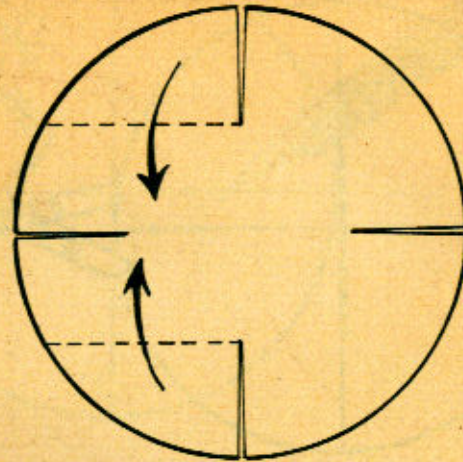


6 Third disc: cut along both horizontal and vertical lines between the halfway marks.

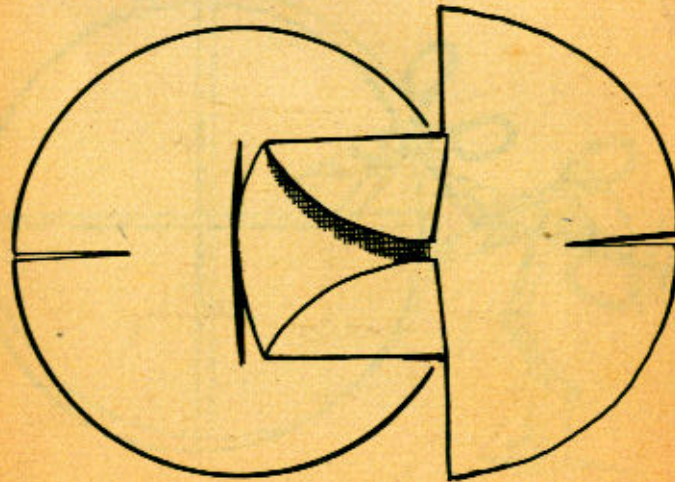




7 The three discs are now ready for assembling. Lightly fold the top and bottom edges of the first disc towards each other; try not to make a heavy crease.

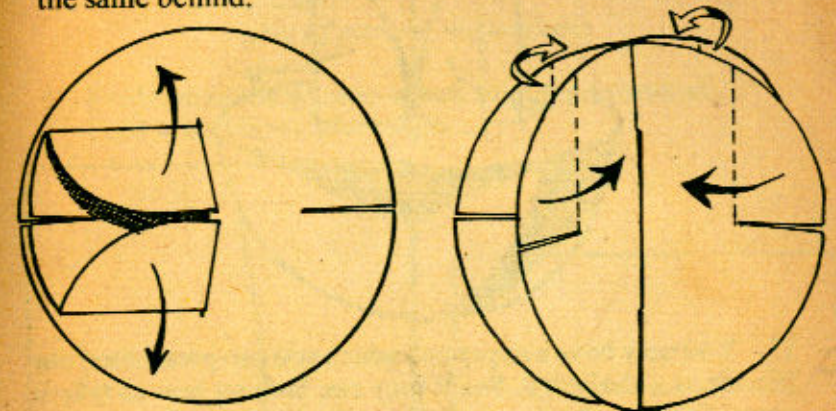


8 Push the folded part of the first disc through the centre slit of the second disc as far as it will go.

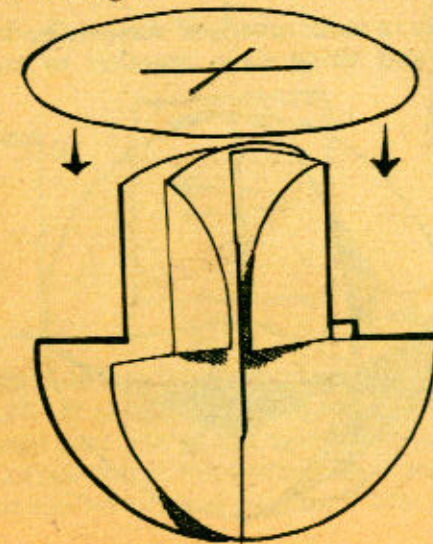


9 On the other side, open up the folds, smooth out the creases and arrange so that the two discs cross each other at right angles.

10 Lightly fold the near top edges back on themselves. Do the same behind.

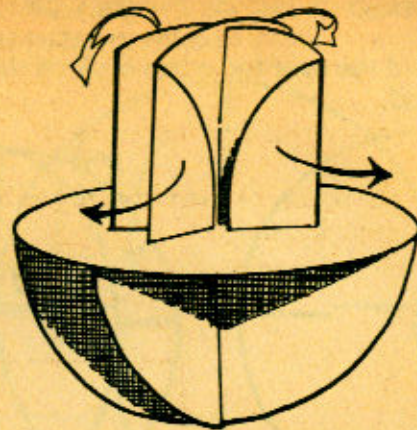


11 Now slip the third disc on to the other two; the folded flaps will pass through the crossed slits of the third disc. Push down as far as it will go.



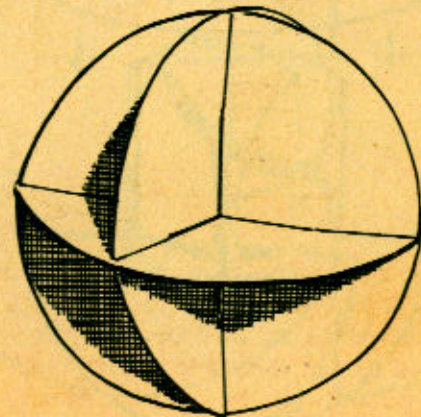


12 Open up the folds and smooth the creases.



13 You now have a paper ball which you can present to your friends as a challenge. See if they can find out how to take it apart. (This can be done, of course, by following the previous steps in reverse, but if you have smoothed out your creases well they may not realise that you put it together by folding certain parts.)

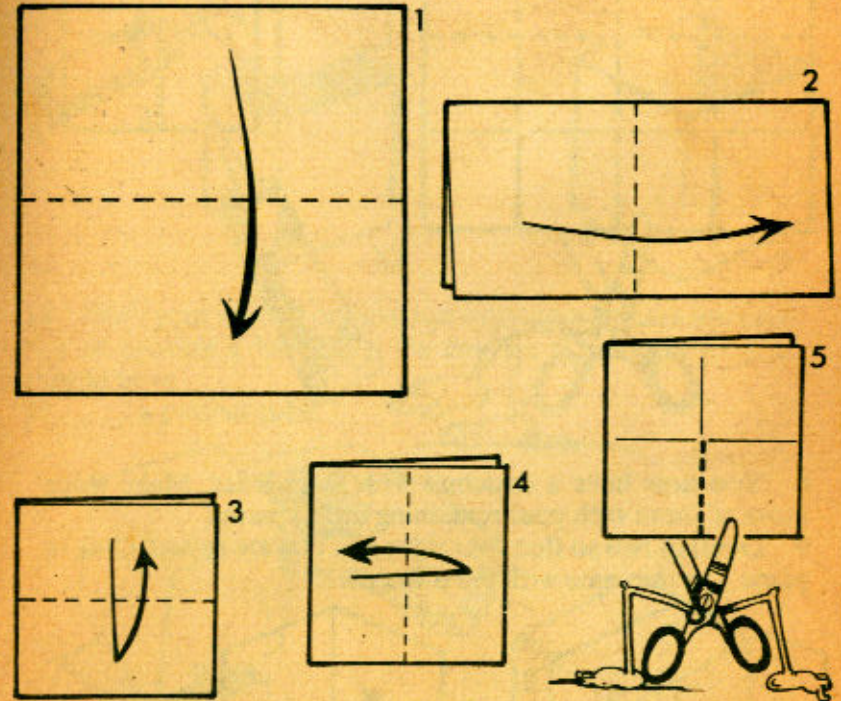
You may like to make several of these balls, decorate them with colours and string them together to make a room decoration.



## Box cube

You will need: *two squares of coloured paper (gummed is best)*  
*scissors*  
*glue (if paper is ungummed)*

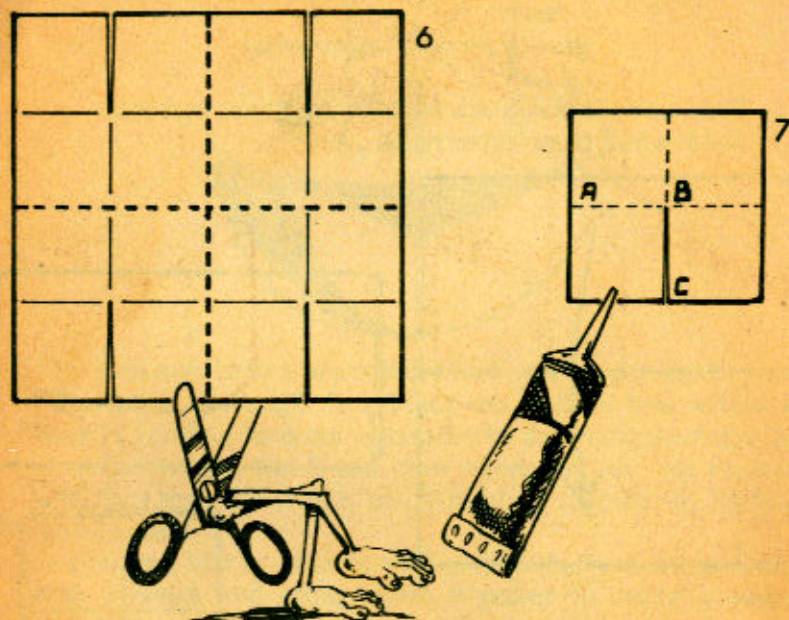
- 1 Fold one of the squares in half from top to bottom.
- 2 Fold in half from left to right.



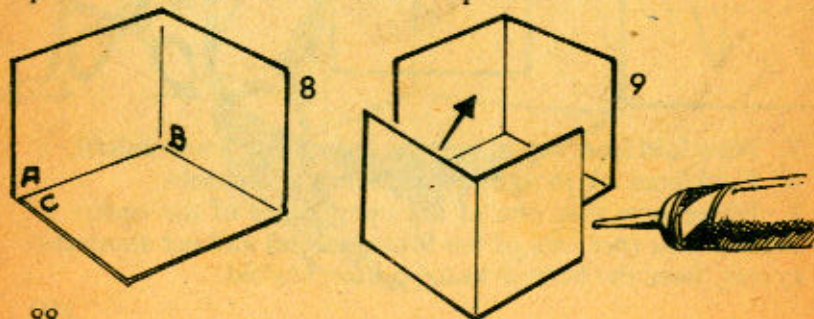
- 3 Now fold from top to bottom; crease firmly and unfold.
- 4 Fold from left to right; crease firmly and unfold.
- 5 Make sure that one of the open edges of the square is nearest you (not one of the folded edges) and cut along the crease, from the bottom to the centre. Unfold.



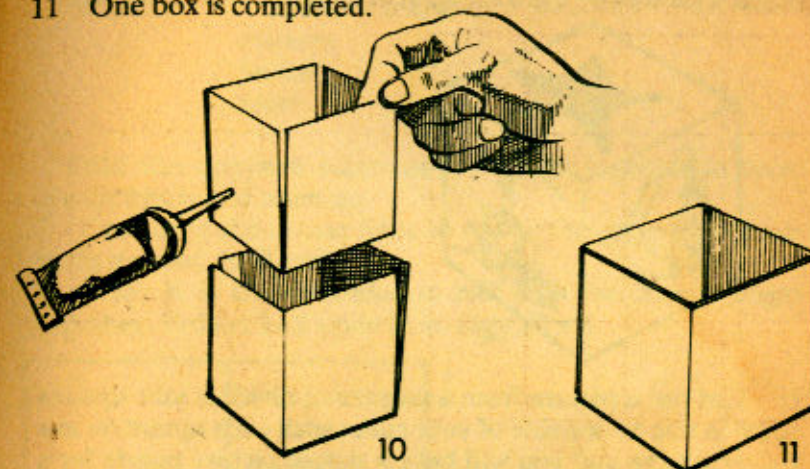
- 6 Cut along the centre creases to make four little squares.  
 7 Take one of these squares; turn it plain (ie uncoloured or ungummed) side up and overlap two of its quarters, so that line BC meets line AB. Glue in place.



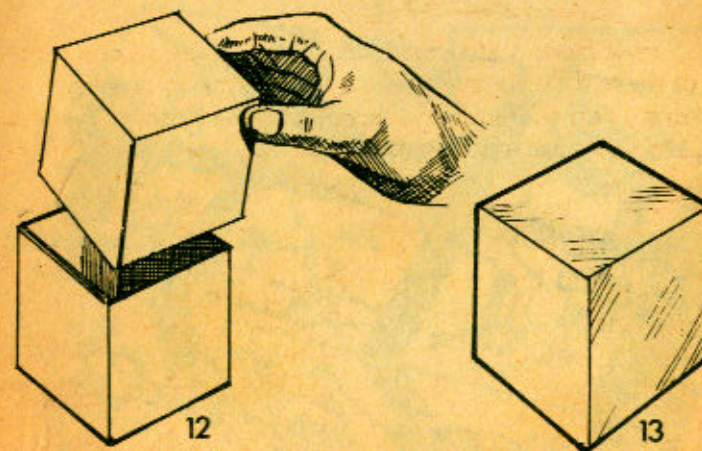
- 8 You now have a structure with three sides. Make three more of these with your remaining little squares.  
 9 Overlap two so that four sides of a box are raised. Glue in place. Do the same with the other pair.



- 10 Now place one of your structures in the other. Make sure that the slit corners of one are placed against the folded corners of the other. Glue in place.  
 11 One box is completed.

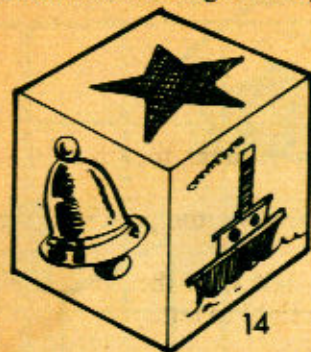


- 12 With your second original square of paper, make another box to provide a lid. When the two are fitted together you should have . . .  
 13 . . . a perfect cube.



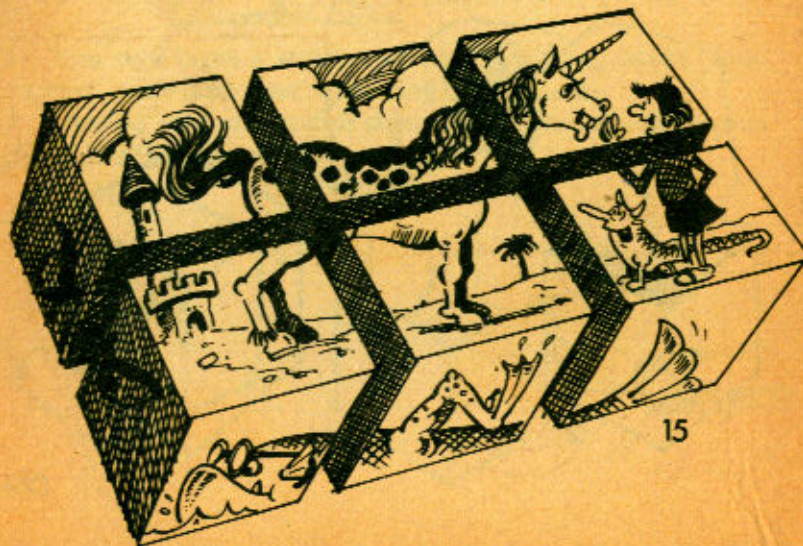


14 Decorate all the surfaces by sticking on cut-out pictures, or gummed paper shapes, and you will have a container for buttons and pins, or paperclips and rubber bands, which might look well on a grown-up's dressing-table or office desk.



15 Cut out a picture from a magazine; divide it into squares equal in size to one side of your cube; stick each square on to a separate cube and you will have a simple picture puzzle for a baby brother or sister to put together.

To make the puzzle interesting you will need to cut out six different pictures in this way. Divide each picture into six little squares – one for every surface of each cube.



### Frame, egg and diamond puzzle

You will need: *one sheet of drawing paper (about 20cm x 25cm)*

*scissors*

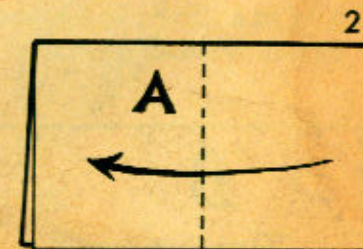
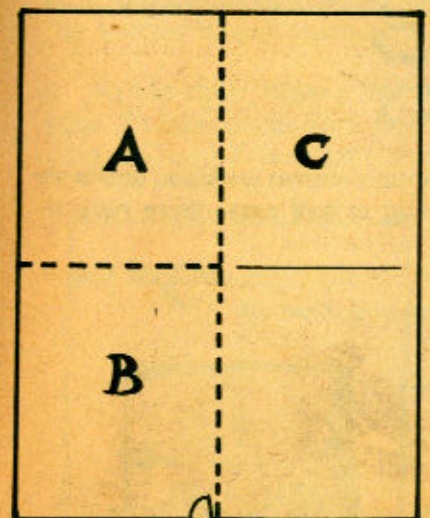
*pencil*

*ruler*

Fold the opposite edges of the paper together in turn; crease firmly and open up.

1 Cut along the crease lines to divide the paper into three parts marked A, B and C.

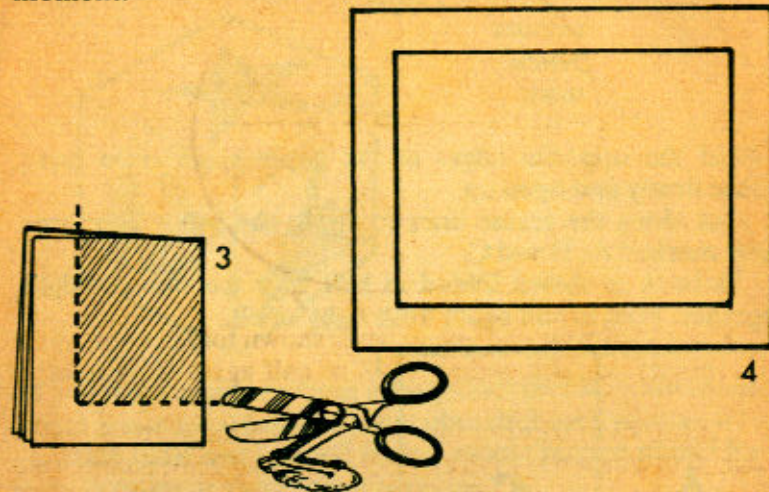
2 Piece A is shown folded in half with the shorter edges together. Fold in half again from right to left.





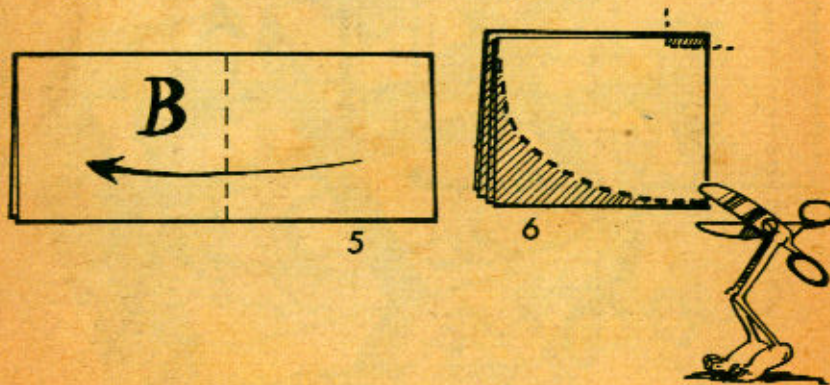
3 Draw lines 1.5cm from the open edges. Cut along these lines; discard the shaded area and open up.

4 You have an open rectangle or frame. Put this aside for the moment.

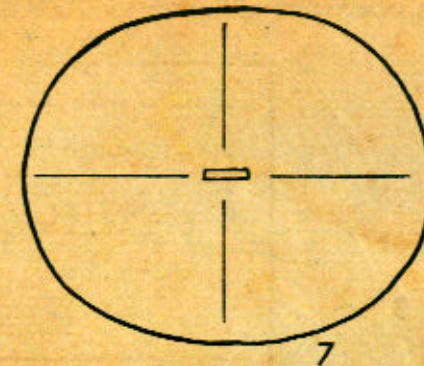


5 Piece B of your original paper is shown folded in half with the shorter edges together. Fold in half again from right to left.

6 Cut a curved line as shown: At top right, cut a slit 1cm in length. Discard the shaded area and open up.



7 You have an oval or egg shape. Put this aside with your frame for the moment.



8 Piece C of your original paper is shown folded in half with the shorter edges together. Fold in half again from right to left.

9 At top right, draw a line 0.75cm from the vertical folded edge. Cut down this for a distance of at least 3cm; then cut the diagonal lines. Discard the shaded area and partially open up.

